INDEXED

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JUNE, 1907.

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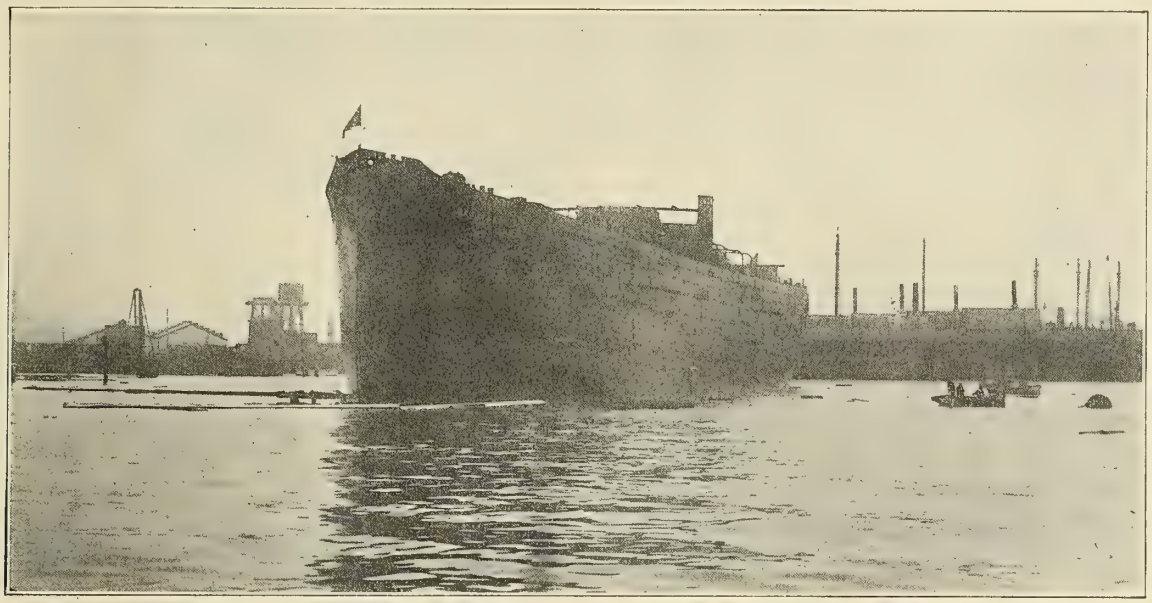
THE NEW STEAMERS MEXICAN AND COLUMBIAN.

BY B. E. D.

The two freighters now being built at the Union Iron Works, San Francisco, are the largest of the American Hawaiian Steamship Company's steamers, being a few feet longer than the *Alaskan, Arizonan,* and *Texan.* The contract was let in June, 1905, and the ships were to be finished in eighteen months. Owing to the scarcity of mechanics, and the damage done by earthquake, delivery has been delayed a few months over contract time.

The leading dimensions of the *Mexican* and *Columbian* are:

Length between perpendiculars	473	feet	3 inches.
Breadth, extreme	57	"	0 "
Depth, molded	35	"	0 "



THE NEW AMERICAN-HAWAIIAN STEAMSHIP MEXICAN FLOATED FROM THE UNION IRON WORKS.

Depth from bottom of keel to shelter deck at center	43	feet	8¼ inches.
Draft to load line	27	"	0 "
Gross registered tonnage	8,579		

Construction is to the requirements of Lloyds, class 100-A-three deck rules, with a complete steel shelter deck. A complete inner bottom is fitted fore and aft, divided into watertight compartments to carry oil and water ballast.

SCANTLINGS.

The midship section drawing shows the general scantling layout. The frames are angles which measure 8 by 3½ by 10/20 inches between frames 45 and 195 and 7 by 3½ by 9/20 inches forward and aft. Web frames are placed on frames Nos. 44, 80, 93, 106, 122, 134 and 175, being 27 inches wide. The spacing of frames is 26 inches.

The deck beams are channels on main and upper deck. On the main deck they are located on alternate frames and measure 12 by 3.9 by 3.9 by 14/20 inches amidships reduced to 12/20 inch at the ends. The frames on the upper deck are the same size except that the thicknesses are respectively 11/20 and 10/20 inch. In wake of hatches, beams are fitted on every frame, measuring 10 by 3½ by 3½ by 12/20 inches on main deck and 10/20 inch on upper deck. At ends of hatches, the beams are 13 by 4.32 by 4.32 by 14/20 inches on each deck. Beams on shelter deck are angle bulbs located on alternate frames and measure 10 by 3½ by 12/20 inches. In wake of hatches they are fitted on every frame, being 9 by 3½ by 9/20 inches. At the ends of hatches there are channels 12 by 3.9 by 3.9 by 10/20 inches. Beams in the forehold on the lower deck are the same as on the main deck.

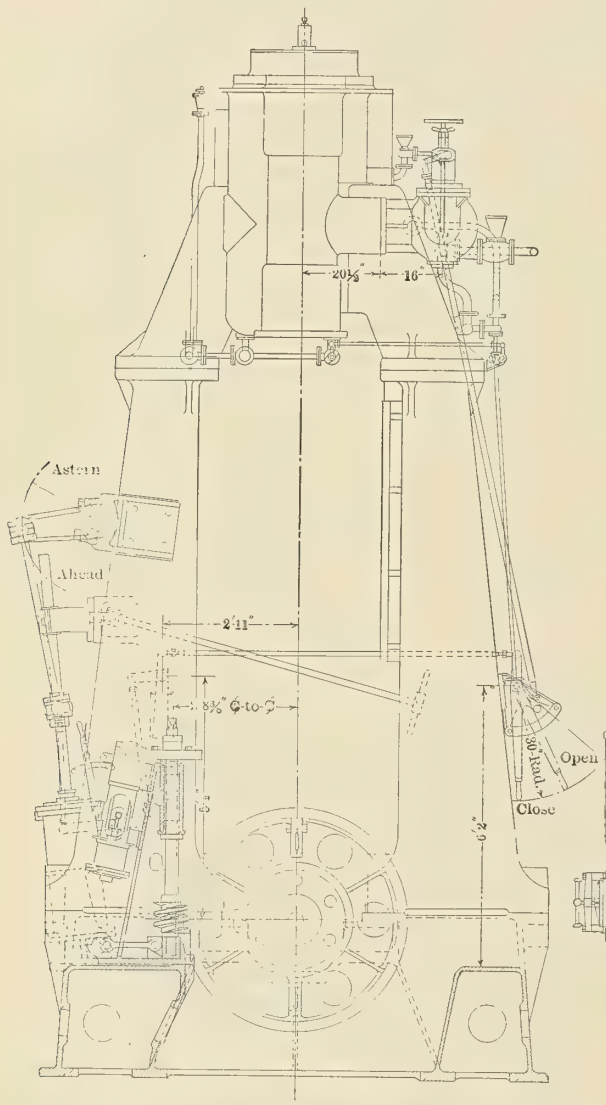
Hold stanchions are of double extra hydraulic pipe, ⅞ inch thick and 6⅝ inches outside diameter. On the main deck these stanchions are 5 inches diameter by ¾ inch thick. On the upper deck, the thickness is 0.68 inch and the diameter 4½ inches.

In the forehold, on the lower deck, the side stringer measures 48 inches in width and decreases in thickness from 10/20 to 8/20 inch at the ends. The plating on this deck is 7/20 inch. The main deck stringer is 75 by 11/20 inches for one-half length, decreased to 55 by 9/20 inches at the ends. The continuous angle connecting this stringer to the reverse frames measures 4 by 4 by 9/20 inches, reduced to 8/20 inch for one-fifth length at each end. The intercostal angles, connecting the stringer to the shell plating, are of the same size. The plating on the main deck measures 9/20 inch for one-half length, decreased to 8/20 inch; it is increased in thickness at the sides of hatches.

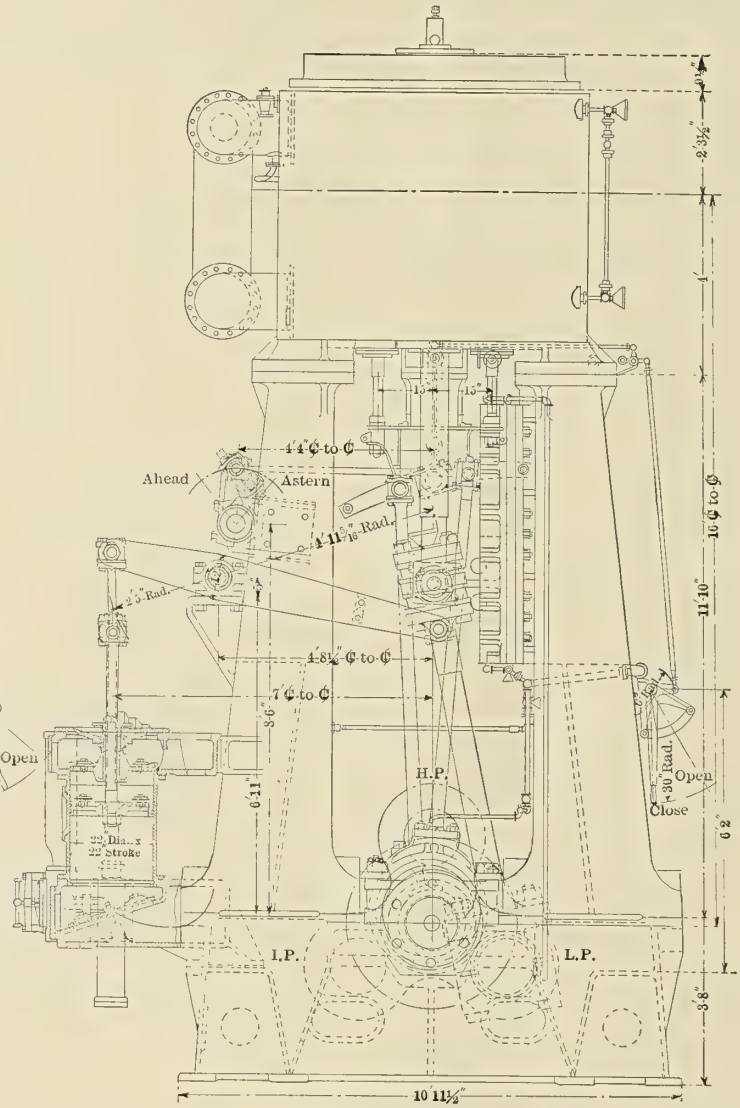
The upper deck stringer plate angles and plating are the same as for the main deck, except that the thickness of the continuous angles is 11/20 and 10/20 inch respectively. The shelter deck

stringer plate measures 59 by 12/20 inches for half length, decreased to 47 by 8/20 inches at the ends. The angle forming the outside of the gutterway, and connecting the stringer plate to the shelter deck sheer strake, measures 4 by 4 by 12/20 inches for three-fifths length, decreased to 8/20 inch at ends. The plating is 8/20 inch, increased at sides of hatches.

The rudder is of cast steel, 1⅝ inches thick at tip, and 3⅜ inches thick at stock. Diameter of head is 10½ inches. Watertight bulkheads are located at frames Nos. 43, 93, 108, 134, and 175. There is a watertight escape trunk from each shaft alley.



HIGH-PRESSURE END OF MAIN ENGINE.



LOW-PRESSURE END OF MAIN ENGINE.

The equipment includes

Two stockless bower anchors of.....	81¼ cwt. each.
One bower anchor of.....	69½ cwt.
One stream anchor of.....	29½ cwt.
One kedge of.....	13¾ cwt.

300 fathoms of 2½-inch stud chain cable,
120 fathoms of 5¼-inch stream steel wire cable.
130 fathoms of 6-inch steel wire tow line, and
400 fathoms of 2¾-inch steel wire hawser.

PROPELLING MACHINERY.

The machinery consists of triple expansion twin-screw engines of 3,600 indicated horsepower, developing a speed of 11.5 knots. The cylinders of each engine have diameters of 24½, 42 and 65 inches, by 45 inches stroke, and will be operated at 82 revolutions per minute. The main engines are 32 feet 6¾ inches high from base of bed plate to top of cylinder covers. From center of crank shaft to center of stroke of piston is 16 feet.

The piston rod is 7 inches in diameter and 7 feet 6 inches between centers, with a 1⅝-inch axial hole. The pistons are 10 inches deep, cast solid on the high-pressure and cored out on the intermediate and low-pressures. The crosshead pins are 8 inches in diameter, 7 inches long and 18 inches between centers. The crosshead brasses are of composition (88-10-2) with a steel back. There are two 2¾-inch bolts to each set of brasses. The crosshead is 17 inches long by 18 inches wide. The connecting rods are 6¾ inches and 8 inches in diameter at the two ends, by 8 feet 6 inches between centers.

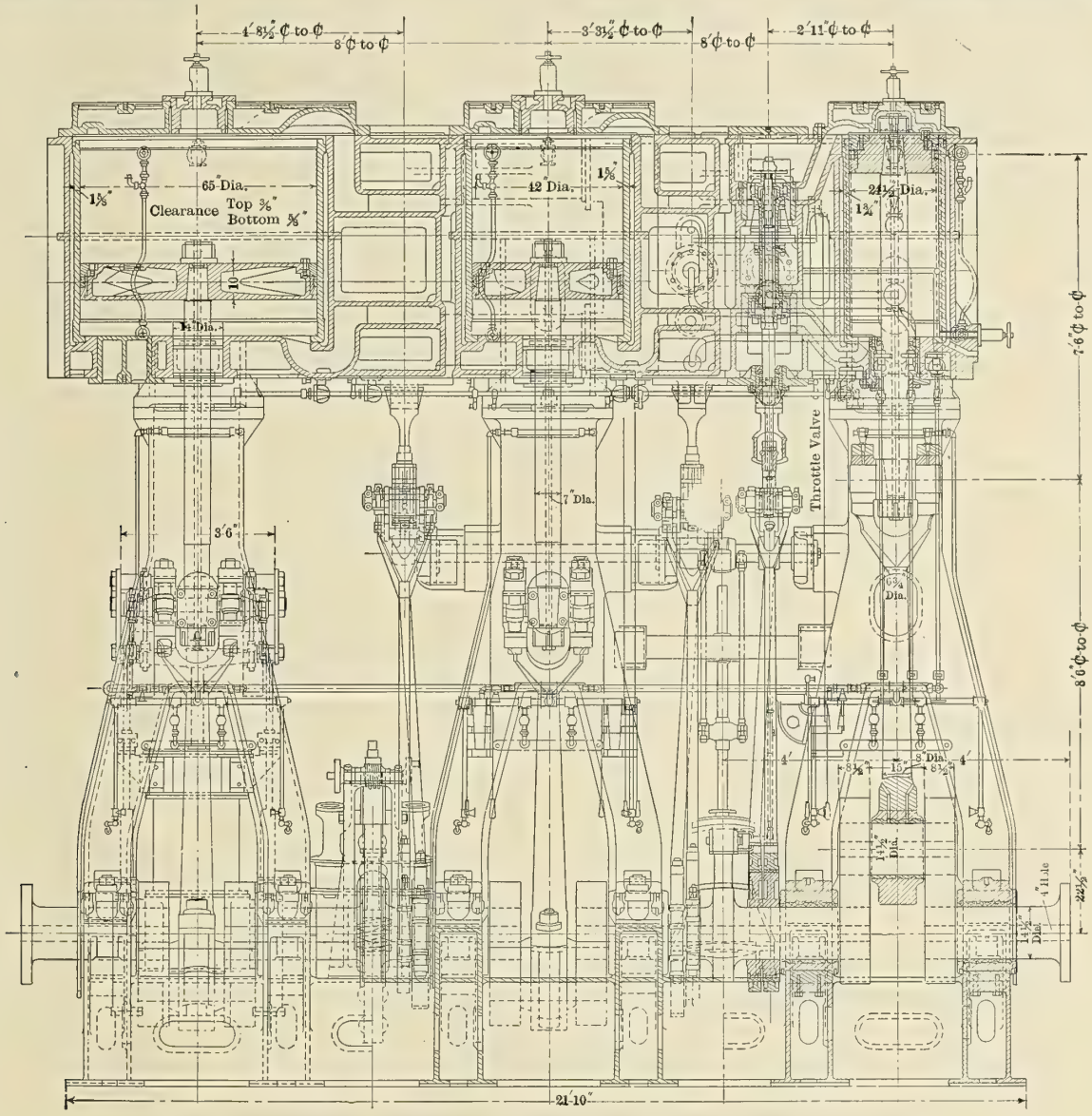
The crank pin "brasses" are of cast steel, 14¾ inches long by 14½ inches bore, with two 3¾-inch bolts. The built-up crank shaft is in three sections, each 8 feet long. The diameter of shaft and crank pins is 14½ inches, with a 4-inch axial hole. The webs are 8½ inches thick. The couplings are 2 feet 6 inches in diameter and 3 inches thick, with six 3¼-inch diameter coupling bolts on a pitch circle 20¾ inches in diameter.

The main bearings are 16 inches long, with two 3-inch holding down bolts. The bed plate is of box section, 21 feet 10 inches long, 10 feet 11½ inches wide and 3 feet 6 inches from center of shaft to base.

The valve stems at stuffing box are 3¼ inches in diameter. Eccentric rods are 2⅞ to 3½ inches diameter, tapered. Piston valves are used on all three cylinders, one on the high-pressure,

12 inches in diameter; two on the intermediate, each 12 inches in diameter; two on the low-pressure, each 16¾ inches in diameter; with a common stroke of 7 inches. The eccentrics are 28 inches in diameter.

The reversing engine is 12 inches in diameter, with a stroke of 25 inches. The diameter of reversing shaft is 5 inches. The turning engine has two cylinders, 7 inches in diameter by 6 inch stroke. The main steam pipe is 7 inches in diameter, and the exhaust to condenser, 24 inches.



LONGITUDINAL SECTION THROUGH ONE OF THE TRIPLE EXPANSION PROPELLING ENGINES.

oil fuel and 288 tons of fresh water in the inner bottom. Two oil and ballast pumps, 10-inch steam cylinders, 8½-inch oil or water cylinders, by 18 inch stroke, are installed in the engine room, for handling liquid. These pumps draw from the sea or inner bottom oil tanks, and discharge to sea, inner bottom and wing tanks outboard of boiler room. The oil burners are of the Lassoe-Lovekin type, which run on a low pressure air system, there being two No. 6A rotary blowers of Wilbraham-Green make, each driven by a 12 by 12-inch engine. Each blower is capable of supplying the air for all of the sixteen burners. These rotary blowers draw their air from the Howden forced draft boxes on the boilers through a duct 18 inches in diameter.

In addition to the rotary blowers, there is a fan blower located on the forward engine room bulkhead, which sucks the air from the engine room and discharges to the Howden boxes. There are two 10 by 10-inch engines, one on each side of the fan. The engines are used alternately, and can easily be connected or disconnected from the fan shaft. The fan is 8 feet 6 inches in diameter, and runs at about 200 revolutions per minute. In addition to the air system, a steam system is fitted, for use when making steam in main boilers, steam being supplied from the donkey boiler.

The oil pumps have 5¼-inch steam cylinders and 4¾-inch oil cylinders, with a 5-inch stroke, and are of the duplex type. They draw from the wing tanks. outboard of boiler room,

BOILERS.

The four single-ended Scotch boilers are 15 feet 6 inches mean diameter, and 12 feet 1⅛ inches long over the heads. The boiler pressure is 215 pounds per square inch. The heating surface of one boiler is 2,900 square feet. There are 116 stay tubes and 246 plain tubes, 3 inches in diameter. The boiler shell is 1⅝ inches thick, with rivets 1 9/16 inches in diameter.

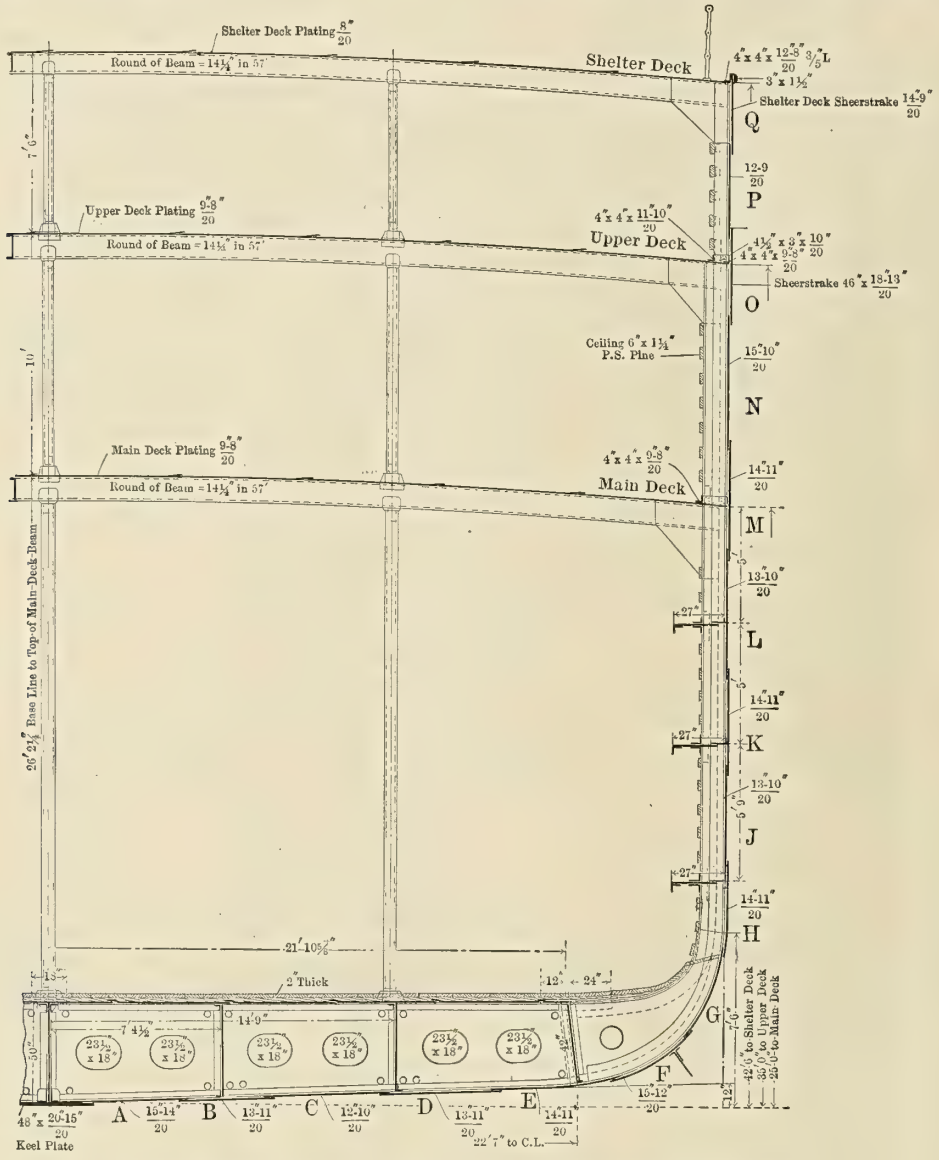
There are four corrugated furnaces to each boiler, 37¾ inches inside and 42 inches outside diameter, and ⅝ inch thick. The length of furnace is 8 feet 4 7/16 inches. The grate area per boiler is 74 square feet, giving a ratio of 1 to 39.2 for grate area to heating surface. The donkey boiler is of the dry back type, 6 feet 9 inches in diameter, with shell ¾ inch in thickness, and designed for 215 pounds working pressure.

The vessels will be built to burn oil as fuel, but can be turned into coal burners at short notice. They will carry 1,540 tons of

through a 2½-inch pipe, and discharge through a heater to burners. A strainer and a meter are located in the suction line. Each of the two oil heaters is 10 inches in diameter by 8 feet long. A coil of 1¼-inch copper pipe with 30.5 square feet of heating surface is used for heating the oil, using live steam or exhaust from the oil pumps. A 1½-inch pipe supplies oil to all of the sixteen burners. This system of oil burning is used on all of the company's steamers using oil for fuel. It gives entire satisfaction, besides being economical.

10-inch engine. The pump suction is 12 inches from the sea and 10 inches from the bilge, with a 12-inch discharge to condenser and sea.

The auxiliary air and circulating pump is of the combined pattern, with cylinders 8 inches in diameter for steam, 10 inches in diameter for water and 10 inches in diameter for air, and a common stroke of 12 inches. The circulating pump sea suction is 6 inches in diameter, with a 6-inch discharge to auxiliary condenser, sea or main condenser. The air pump suction is 6



MIDSHIP SECTION OF THE MEXICAN, SHOWING DISTRIBUTION OF SCANTLINGS.

AUXILIARY MACHINERY.

Two condensers are located, one each to port and starboard of the main engines. Each condenser contains 1,823 ¾-inch tubes, 10 feet long and of No. 17 B. W. G., giving 3,500 square feet of cooling surface. The body and heads are of cast iron. The diameter of body is 5 feet. The auxiliary condenser is of cast iron, 3 feet in diameter, and containing 638 tubes ¾ inch in diameter, 8 feet long and of No. 17 B. W. G., giving 1,000 square feet of cooling surface.

The air pump is 22 inches in diameter by 22 inch stroke, with a 3½-inch diameter by 22-inch stroke sanitary pump on the forward side, all driven off the low-pressure cylinder. The air pump suction from condenser is 8 inches in diameter, with an 8-inch discharge overboard, and a 5-inch discharge to feed and filter tanks. The circulating pumps for main condensers are of the centrifugal type, with a 42-inch runner, each driven by a 10 by

inches from auxiliary condenser, and 3½ inches from main condensers, with a 3½-inch discharge to feed tanks. The auxiliary air and circulating pump, as thus connected, can be used when warming up the main engines, previous to starting.

A fire and bilge pump, 10-inch steam cylinder, 8½-inch water cylinder, by 18-inch stroke, is located on the after engine room bulkhead, above the thrust recess. The suctions are 7 inches from the sea, and 5 inches from the bilges. The discharges are 4½ inches to fire main, 5 inches overboard, and 6 inches circulating water to main condensers.

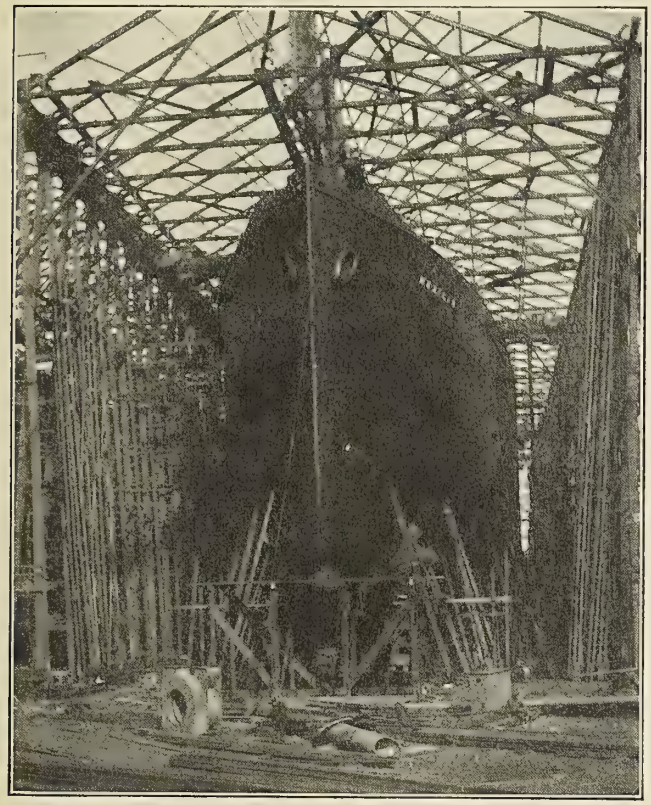
One auxiliary and two main feed pumps, having cylinders 10 inches for steam and 8½ inches for water, by 18-inch stroke, are installed in a row in front of the feed tanks. The two main feed pumps have 4-inch diameter suction from feed tanks, and a 3½-inch suction from main boilers, fresh water tanks and condensers. The discharge is 3½ inches overboard or to boilers.

The auxiliary feed pump suction from sea and feed tanks is 4 inches diameter with a 3½-inch suction from boilers and fresh water tanks.

Each feed pump will discharge through main or auxiliary feed line direct to boilers, or through reflex filters and feed heater to boilers. A 2-inch Metropolitan injector is also installed for feeding boilers.

The donkey feed pump is 4½ inches steam, 2¾ inches water by 4-inch stroke, wth a 2-inch suction from fresh water tanks and feed tanks. The discharge to boilers is 1¼ inches in diameter.

All independent pumps, with the exception of the 12-inch centrifugal pump, are of the Dow pattern. No manifold valve boxes were used on these ships, all switching and by-passing being done through separate valves.



BOW VIEW OF MEXICAN BEFORE LAUNCHING.

A 3½-inch auxiliary steam and a 6-inch auxiliary exhaust line make a complete circuit of the engine room, with cut-out valves conveniently placed, in case of accident in any part of the line. All valves in the steam line, and where possible in the exhaust and water lines, are placed with vertical stems, making it easier for the engineer to regrind the valves. There are three 8-inch back pressure valves in the auxiliary exhaust line, one to each condenser, set to give a back pressure of 10 pounds per square inch in the feed water heater. The latter is of the horizontal tubular type, containing 192 1-inch copper tubes, tinned, 8 feet long, of No. 10 B. W. G., giving 400 square feet of heating surface. It will raise the boiler feed water to 220 degrees Fahrenheit.

The two evaporators are located in the thrust recess, outboard of the thrust block. The diameter of shell is 4 feet 6 inches.

There are two 20-kilowatt generator sets in the thrust recess, between thrust blocks. They are fitted with General Electric generators, driven by 9 by 7-inch engines built by the Union Iron Works.

The refrigerating plant is located on the upper deck, amidships, aft of engine room, and has a capacity of 1,000 pounds of ice, besides refrigerating 1,200 cubic feet of cold storage space.

The steam steering gear consists of two 10 and 10 by 10-inch vertical engines, direct connected to a quadrant of 8 feet radius, by spur and bevel gears. Each engine is on a sliding sole plate, so that they can be used alternately.

GENERAL.

The deck machinery consists of one 10 and 10 by 16-inch windlass, two 8 and 8 by 10-inch capstans, four 8 and 8 by 8-inch vertical winches and ten 9 and 9 by 12-inch horizontal winches.

The propellers are 15 feet 6 inches in diameter, and 17 feet pitch, with an adjustment from 16 to 18 feet. The pitch ratio is 1.097 as set. Each wheel consists of bronze blades, with a cast steel hub. The projected area is 60 square feet, and the helicoidal area is 71.5 square feet. The projected area is 0.318 of the disk area. The engines turn the propellers outboard.

Forward of the boiler hatch is located the dining saloon, and four staterooms of two berths each, for passengers. The galley is between the engine and boiler hatches.

Above the engineer's quarters, aft of the engine hatch, are the staterooms for the officers, with the captain's quarters forward of the boiler hatch. On the upper deck forward are quarters for a boatsman, carpenter and the quartermasters, with store rooms and carpenter shop.

The crew's quarters are on the upper deck aft. The seamen's and firemen's quarters consist of twelve berths each. The crew's wash rooms and toilets are located aft of the quarters. Amidships, around the engine and boiler hatches on the shelter deck, are the quarters for engineers, water-tenders, freight clerks, steward, cooks, messmen, etc. Two hospitals are located on the upper deck, just forward of the crew's quarters, with accommodation for four persons each. One hospital can be used for contagious diseases.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports under date of April 11, 1907, the following percentage of completion of vessels building for the United States Navy:

	Tons	Knots		Mar. 1	Apl. 1
BATTLESHIPS.					
Nebraska	14,948	19	Moran Brothers Co.	99.	99.2
Kansas	16,000	18	New York Shipbuilding Co.	98.	99.6
Mississippi	13,000	17	Wm. Cramp & Sons	76.25	81.38
Idaho	13,000	17	Wm. Cramp & Sons	69.77	73.66
New Hampshire	16,000	18	New York Shipbuilding Co.	63.5	64.7
South Carolina.	16,000	18½	Wm. Cramp & Sons	7.74	9.38
Michigan	16 000	18½	New York Shipbuilding Co.	8.29	11.1
ARMORED CRUISERS.					
California	13,680	22	Union Iron Works	98.8	99.6
South Dakota.	13,680	22	Union Iron Works	95.9	97.1
North Carolina.	14 500	22	Newport News Co	73.28	75.81
Montana	14,500	22	Newport News Co	68.26	70.92
SCOUT CRUISERS.					
Chester	3,750	24	Bath Iron Works	67.79	71.9
Birmingham	3,750	24	Fore River Shipbuilding Co.	64.1	67.4
Salem	3.750	24	Fore River Shipbuilding Co.	64.2	68.3
SUBMARINE TORPEDO BOATS.					
Cuttlefish	—	—	Fore River Shipbuilding Co.	91.	91.5
Viper	—	—	Fore River Shipbuilding Co.	89.1	90.6
Tarantula	—	—	Fore River Shipbuilding Co.	92.5	92.5
Octopus	—	—	Fore River Shipbuilding Co	88.9	90.42

Japanese Inspection of Steamships.

The Department of Commerce and Labor advises that the Japanese government will recognize as valid the steamship inspection certificates issued by the United States to American steamers, and will dispense with any further inspection as regards hull, boilers, machinery, equipment, and life-saving apparatus, except such as is necessary to satisfy the inspectors that the condition of the vessel, boilers and life-saving apparatus are as stated in the American certificate which she holds.

THE EVOLUTION OF THE MODERN CARGO STEAMER.*

BY S. J. P. THEARLE.

STRUCTURE.

We may now approach the subject of the structural evolution of the cargo steamer. At the date from which we commence our survey, steamers and sailing vessels were closely alike in their construction. The typical midship section of that period consisted of floors, frames, reverse frames, keelsons, beams, stringers, shell plating, and decks. Speaking in general terms, transverse stresses were resisted chiefly by means of tiers of beams. The frame girder was the simple frame and reverse frame arrangement, which dated from the earliest days of iron shipbuilding, and double bottoms had not, except in coasting colliers, taken the place of the floors and keelsons common to the same period. Steamers were built with decks and tiers of beams in number proportionate to the vessel's depth, measured from the top of keel to the top of the upper deck beams. For instance, the steamer 24 feet in depth to upper deck would have two complete decks, and a tier of hold beams in addition. Increases in depth would be accompanied by additions to the side stringers, until at length a depth would be reached requiring another tier of beams, and so on. Hence in large steamers the hold space would be much broken up, from a stowage point of view, by the presence of many decks and tiers of beams. In passenger vessels, and vessels for other special trades, it is still the practice to multiply decks and tiers of beams in this way, with results contributory to the purpose for which the vessel is intended. But in ordinary cargo vessels these arrangements are obstructive. They not only serve to reduce the stowage capacity of the vessel, but they add very considerably to the weight of the structure. It is no doubt true that a cross-tie is a most efficient mode of supplying transverse strength, having regard to the weight of material employed for the purpose, but it seems doubtful whether so much transverse strength was really required as was contributed by the numerous decks and beams at one time fitted in all cargo steamers.

When the presence of tiers of hold beams and wide side stringers in the hold became objectionable, it was at first sought to compensate for their omission by fitting a series of extra strong frames, termed "web frames," spaced at regular intervals, and associating them with a series of stringers of the same depth. These web frames were really partial bulkheads, of from 15 to 18 or 20 inches in breadth, and they were spaced from four to eight frame spaces apart, according to the circumstances of the case. Between the web frames the ordinary frames were situated. As already remarked, there were associated with the web frames one, two, three, or more side stringers of the same depth as the web frame and of equal scantling, and web frames and side stringers were united at their intersection by plates of lozenge form, known as "diamond plates," which were afterwards modified to a triangular form, known as "half-diamond plates."

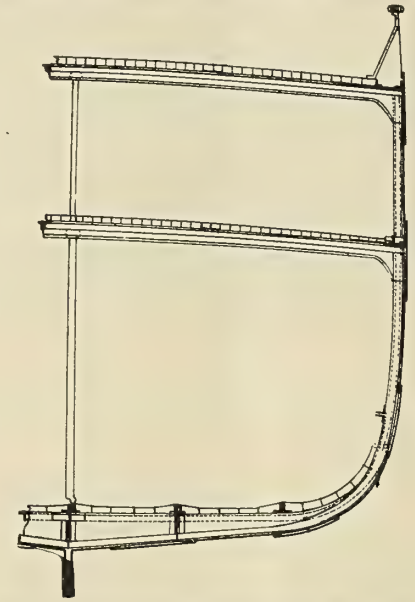
This arrangement is still adopted by some shipowners, and especially by some foreign owners, whose preference for it is due to the prospect of increased tonnage measurement and consequent higher subsidies. The arrangement has proved to be an excellent one from a structural point of view, but it has disadvantages resulting from the interference with cargo stowage, and the difficulty of keeping the stringers free from the decaying materials left after discharging grain cargoes.

The form of compensation for the omission of tiers of beams and of wide stringers in hold which has received the greatest approval is that known as "deep framing." The earliest form of deep frame was a combination of frame and reverse frame of increased size, and this was associated with heavy side stringers. It gives a reduced tonnage measurement as compared with ordinary frames or web frames, which is an advantage to the British shipowner, but not to the shipowner who seeks his profits in government subsidies.

*Read before the Institution of Naval Architects, March 21, 1907.

As already remarked, the earliest deep-frame vessels had heavy side stringers associated with the strong frame girder. The depth of these stringers was, however, rarely sufficient to make them of structural value as girders, having regard to the length of a cargo hold from bulkhead to bulkhead. It has therefore been found advantageous in more recent years to reduce these side stringers very considerably, until at length they serve no other purpose than that of stiffeners to the shell plating, and to prevent any tendency to side tripping in the frames. The weight saved in the stringers has been largely employed in lightening the structure, but a part of it has been utilized in giving additional strength to the frame girder. The tendency at the present day is in the direction of a still further diminution of the material used in the side stringers of deep frame vessels. It need hardly be pointed out that the deep frame system with small side stringers is specially adapted for being insulated in the manner found necessary when refrigerated cargoes are carried in the hold.

While considering the question of evolutionary change in transverse framing, we must not omit to notice the various forms of frame section which have from time to time taken the place of the early frame and reverse frame combination. These have consisted of zed frames, channel frames, and bulb angle frames. The zed frame has not been extensively used in the mercantile marine, but the channel frame presents many advantages to the shipbuilder, and has often been and still is adopted both for frames and beams. The form, however, which seems most likely to prevail is the bulb angle frame, and that too as much by reason of its durability as from any other cause. It has always been noticeable that wasting by corrosion, in the framing of iron and steel vessels, takes place much more rapidly at the inner or fore and aft flange of the reverse frame than at any other part of the frame combination. This has been specially remarked in bunkers and other parts of the vessel where the wasting is most rapid.

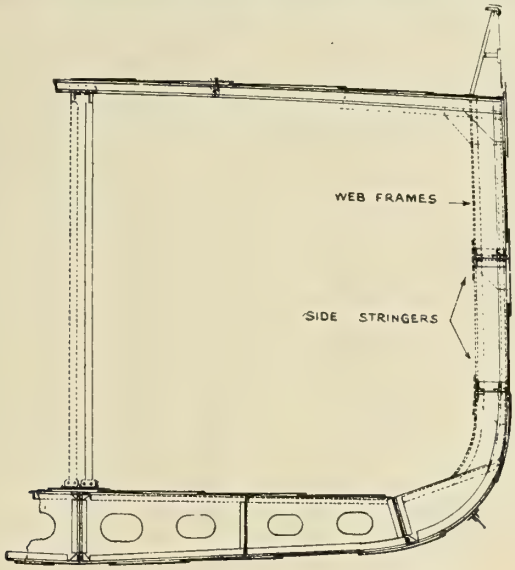


MIDSHIP SECTION OF TRAMP STEAMER OF 1870.

For this reason bulb angle framing was adopted, many years since, in the bunkers of steamers, with most satisfactory results. The bulb of the section is found to resist that tendency to rapid oxidation which is so observable with reverse frame angles. Hence bulb angles were used for the framing of steam colliers in the cargo holds and elsewhere, and during recent years bulb angle framing has been largely employed for ordinary cargo steamers. Bulb angle sections are now rolled of sizes suitable for "deep frames," that is to say, for the frames of vessels in which tiers of beams and stringers have been omitted in order to provide unobstructed cargo holds.

In no respect have the structural developments of recent years,

in cargo steamers, been more important than in regard to this one of framing. Steamers up to 28 feet of molded depth have of late years been built with only one deck, and they are doing their work at sea in a most satisfactory manner. Thirty years ago very few steamers of so large a size were being built at all, and those which were built had two decks and three tiers of beams with wide hold stringers. Subsequently, such vessels had two decks and web frames. Following this modification, steamers of a large size were built with deep framing and a tier of beams; but now we have them with still stronger deep framing, often of bulb



THE WEB FRAME SYSTEM OF CONSTRUCTION.

angles, and having only one deck, and no hold beams. Other developments of a most important character have proceeded simultaneously with those relating to the framing, and will presently be considered, but the very strong "deep framing" of the modern cargo steamer is her most prominent and noteworthy characteristic.

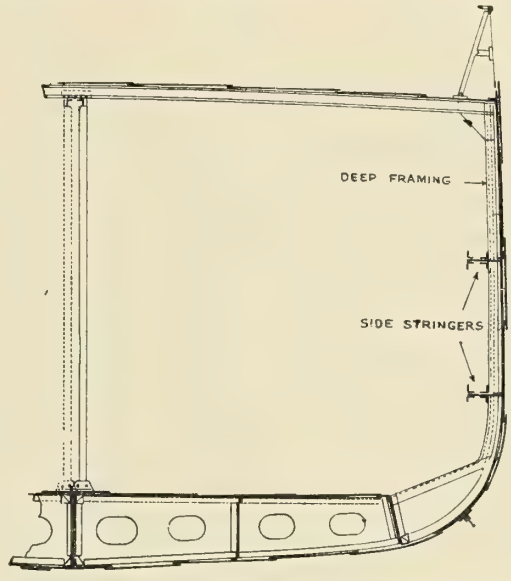
At the period from which our survey commences, the coasting screw collier was already fitted with a double bottom constructed on the McIntyre system, for carrying water ballast when not loaded with coal. Ships of the Royal navy had been for some time previously framed on the cellular system, but about thirty years ago the system was first applied to the construction of the double bottom of cargo steamers. At first the system was much handicapped by the fact that, although the cellular spaces in the double bottom could not be used for carrying cargo, yet the tonnage measurement authorities measured all that portion of the space above the level of where the tops of the floor plates would be in the ordinary style of construction. When once the law allowed the cellular double bottom spaces to be excluded from tonnage measurement, a great impetus was given to that mode of construction. This was more than twenty-five years ago, and, whereas at that time cellular double bottoms were unusual, and ordinary floors and keelsons almost universal in the mercantile marine, at the present day all but the smallest steamers are fitted with double bottoms, and this, too, not only for the purpose of carrying water ballast, but also because of the great structural value of the system, and the share it contributes to the strength of the vessel.

The McIntyre tank, which consists of an inner bottom riveted to the tops of longitudinal girders standing on the tops of ordinary floors, is still occasionally fitted in somewhat large steamers, but it has not the structural value of the cellular double bottom. At first it was very usual to fit the floors of a cellular double bottom at alternate frames only, and to fit a greater number of longitudinal girders than are found to be sufficient when the frames are fitted at every frame. Even at the present day this practice is followed at some shipyards on the northeast coast, but the more general practice is to fit floors at every frame, associated with a lesser number of longitudinal girders. Probably the depth of the double bottom is determined rather by water ballast requirements than by structural strength, and is perhaps otherwise in excess in most cases of what is absolutely required. But the general efficiency of the system is now well established, as is also the necessity for providing some margin of thickness against the tendency to corrosion, which under boilers is usually very considerable.

The extra stresses attending the navigation of steamers across the North Atlantic in a light condition during winter have already been alluded to. Notwithstanding the great structural value of a double bottom, the effect of "flogging" the seas when light and trimmed by the stern has nevertheless been to greatly distress the riveting at the fore part of the double bottom of full-bowed vessels, and even to indent their plating. It has therefore been found necessary to afford additional strengthening at that part in all vessels of full form intended for that work, which means that practically all cargo steamers have to be so strengthened. This is one of the penalties which the British shipowner has to pay on account of the United States tariff laws.

These remarks on cellular double bottoms would be incomplete if brief allusion were not made to the employment of liquid fuel in steamers, which was started about eight years ago, and the use made of the cellular double bottom for carrying the oil.

Great changes have been effected of late years in the pillaring of decks of cargo steamers. The shipowner has at all times a strong desire to have his steamer so constructed that as few

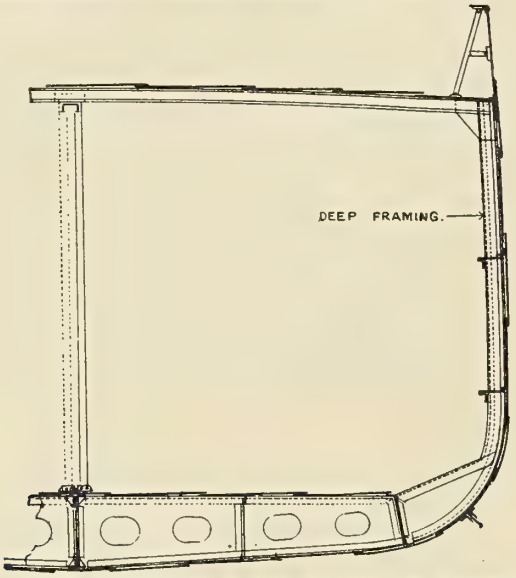


DEEP FRAMING ASSOCIATED WITH HEAVY SIDE STRINGERS.

obstructions to cargo as possible may be offered in the arrangement of the material of which she is built. Pillars are at all times a rock of offence to the shipowner, as they break stowage and interfere with loading and discharging. Among the important developments undergone by the cargo steamer has, therefore, been that involved by a reduction in the number of pillar supports to the deck or decks. This has been of a twofold character, for a reduction could not be effected in the number of pillars without increasing the strength of those which were allowed to remain. Also a concentration in the pillaring supports must be accompanied by means for the due transmission of the support given by such concentrated pillaring. Hence it has become a common practice to fit a few very strong pillars, and to additionally support the deck beams by fitting strong girders under them, with an intercostal attachment, so as to transmit the pillar support over all the deck. It is hardly necessary to follow this point into further detail; the main principle will be obvious from the foregoing remarks, and it will be seen that they indicate changes in

cargo steamer construction of a most important and far-reaching character. The possibilities are great, and are limited only by the question of cost and by weight of structure. By making beams and girders of sufficient strength, pillars might be wholly dispensed with, due attention being, of course, paid to such additional stresses as would be brought on other parts of the structure. The penalty to be paid is, however, in every way a costly one, and is justified only by the attainment in the vessel's design of a purpose of corresponding importance.

Incidental reference has already been made to the transference of materials from the upper deck sheerstrake, deck plating, and stringer, as well as from the upper strakes of shell plating, to the side plating and decks of long erections, which has been increasingly taking place for some years past in large cargo steamers.



A LATER DEVELOPMENT OF DEEP FRAMING AND STRINGERS.

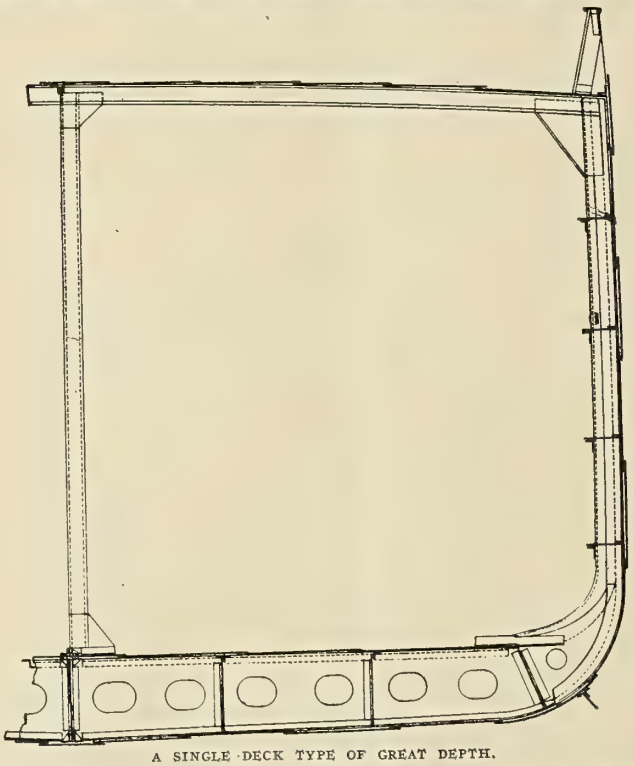
As bridge houses were increased in length, it was observed that their scantlings were not sufficient to effectively resist the stresses brought upon them. The bridge deck plating and stringers and the upper strakes of bridge side plating were sometimes found to have been torn after heavy weather had been encountered, and in cases where passenger saloons were placed in long bridge houses it was often found impossible to keep them watertight. At first this difficulty was occasionally got over by deliberately cutting the erection in two and making a watertight sliding joint, the yielding of which was a preferable alternative to rupture or leakage. But at length it became apparent that the better course would be to treat the long erection as the upper member of the girder, and strengthen it accordingly. Then began the transference of materials from the range of the upper deck to that of the bridge deck, which has since developed until at the present time the shelter deck, which grew out of the long bridge house, has deck and side plating suitable for the stresses which are encountered at that part, and a corresponding reduction has been made in the scantlings of the deck below, which formerly was the "strength deck" of the vessel.

The outcome of this evolutionary movement has been that spar decks get the scantlings which formerly went to main decks, and where the spar deck is surmounted by a long bridge, a further transference of scantling to that height has been made throughout the length of the erection. Awning decks have received similar treatment when adopted in large steamers, which are, however, now usually built more frequently of the shelter-deck type.

In the earliest cargo steamers the decks were usually of wood, and in vessels of comparatively small size such decks were found to be generally sufficient. In the larger vessels iron decks were necessary in order to obtain the requisite structural strength, and these were often sheathed with wood. The wear and tear of a wood deck in a cargo steamer is considerable, so that even so far back as twenty years ago it was becoming a very usual practice to make the weather decks of iron, unsheathed; and where a vessel was large enough to require two iron decks for structural purposes, neither of them would be sheathed. The arrangement proved to be both efficient and economical, so that it became increasingly prevalent, until at the present day decks are rarely sheathed with wood except in vessels intended for carrying passengers. The only economical objection to the practice is that of the rapid wasting by corrosion which goes on in iron or steel decks, especially the latter, when exposed to the action of sea water. There are no structural objections to the omission of a wood sheathing, provided the beams be sufficiently close to efficiently stiffen the plating of the deck. At present there is an increasing tendency to space beams at every frame under the plating of weather decks, and the tendency is a good one.

The desire to have roomy cargo holds with unbroken stowage, which has given rise to the building of so many large single-deck steamers, has further resulted in a thickening of the deck plating, which is advantageous, not only by reason of its structural value, but also because of its greater durability. The deck plating is increased in thickness in order that, in co-operation with other additions, the necessary strength may be afforded to a vessel having only one deck. But being thick on that account, it serves other very useful purposes, especially in view of the buckling tendencies which decks experience in these days when concentrated ballasting amidships is unfortunately so often resorted to.

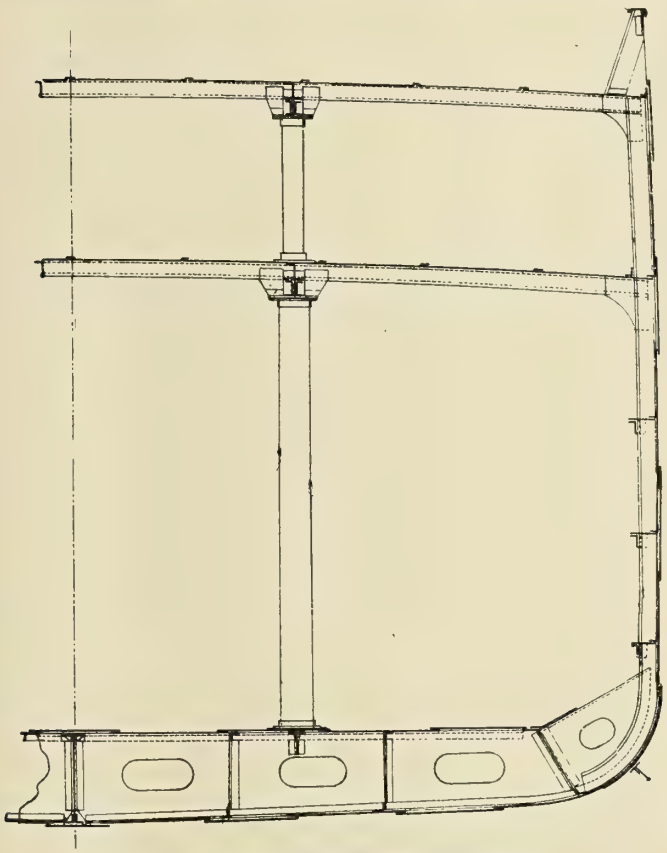
It cannot be said that the evolution of the cargo steamer has of late been attended with any increase in bulkhead subdivision, but the bulkheads are much better stiffened than formerly. The standard subdivision of ordinary cargo steamers remains the same as it was twenty years ago. The steamer up to 280 feet long classed with Lloyd's has four bulkheads; up to 330 feet she has five. Thence to 400 feet she requires six, and to 470 feet seven. Beyond these lengths steamers are something more than ordinary cargo carriers. In fact, the great majority of modern cargo steamers are less than 400 feet in length. During recent years a strong desire has been often manifested to dispense with one or more bulkheads in large cargo steamers, the object in most cases being to stow large machinery or long logs of timber or something else which the usual cargo hold is too short to receive. Structural compensation for the absence of one or two



A SINGLE DECK TYPE OF GREAT DEPTH.

bulkheads can be very easily supplied, so that there is no difficulty in complying with the owners' desire so far as the strength of the vessel is concerned. But whatever element of safety to ship and crew is forfeited by the omission of a watertight bulkhead cannot be supplied in any other way. It is no doubt true that the standard bulkhead subdivision of the holds of a cargo steamer is not in all cases a guarantee of safety against sinking if one compartment be open to the sea; but despite this it would be a matter for regret if less rather than more subdivision were to be sought, and it is hoped, therefore, that the tendency to which reference has been made will not be an increasing one.

With the desire to get larger and clearer holds has grown a desire to get longer and wider hatchways. Here, again, the structural possibilities admit of the strength of the vessel being maintained up to the limits of size hitherto sought. Moreover, the precautions taken to efficiently close in the openings at sea and support the hatches against weather stresses are better than they formerly were, so that there are no grounds for anxiety in these particulars.



THE USE OF STRONG PILLARS AND GIRDERS.

The evolution of the cargo steamer during the period which we select for our retrospect has been materially influenced by the introduction of mild steel into shipbuilding. It would be scarcely possible to exaggerate the beneficial influence which the substitution of that material for iron has had upon the development of the cargo steamer. Not only have we had an ideal material to deal with, but improvements in the steelmaker's art have resulted in the production of sections more and more suited for the shipbuilder and the ship. He has given us longer and broader and thicker plates; longer and heavier bars, smoother surfaces, and in every respect better structural materials upon which to work. This improvement in quality and suitability of material has had its influence upon the quality of workmanship as seen in the fitting together and the riveting. The whole result is that, during the twenty-five years or thereabouts that mild steel has been used in shipbuilding, workmanship and finish have been always improving, so that the cargo steamer of today is a better and a stronger vessel, both absolutely and also in proportion to her scantlings, than ever she has been before. It remains to be seen whether further improvements will be made in steel manufacture, and whether a low-priced, trustworthy steel of higher tenacity than is used at present will be produced, having all the excellent qualities of the mild steel now employed in shipbuilding. Should such an article be forthcoming it may be expected that, with it, still further advances will follow in the evolution of the cargo steamer.

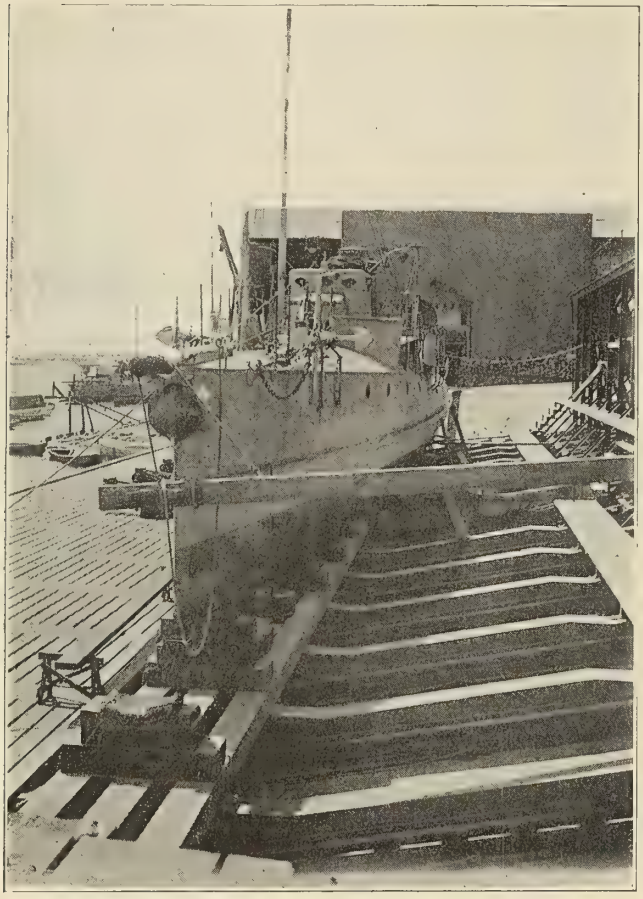
It would unduly prolong this paper were attention given to all the modifications which have been made in the mode of combining materials in the cargo steamer. The common use of lapped in lieu of the older-fashioned strapped butts, the now common practice of joggling the edge laps of plating in order to dispense with the use of liners, and also the joggling of frames and beams in order to effect the same result, are instances of such modifications, which serve the purpose of reducing the weight of the structure without diminishing its strength. These have become possible only in consequence of the excellence of the material used in shipbuilding. On every hand, by means of better machinery and in other ways, improvements in the modes of doing the work are being effected, and at the same time the cost of production is being diminished. Tramp steamers have not yet been standarized, but successful designs for the purpose are now often duplicated, and we have got so far as the standarization of the sectional material used in their construction. Whether the time will ever come when tramp steamers will be as like one another in point of dimensions and design as are Thames barges it is at present impossible to determine; but we have some justification for supposing that the evolutionary changes now in progress are bringing that description of vessel nearer and nearer to a standard ideal.

A Ship Canal Across Cape Cod.

It is expected that within the next three years there will be completed a ship canal eight miles long, extending in a straight line from Buzzards Bay on the south of Cape Cod to Sandwich, off Barnstable Bay, on the north. The depth will be 25 feet at low water and 30 feet at high water, there being no locks or obstructions of any sort. The minimum width will be 125 feet at the bottom and from 250 to 300 feet at the surface, with four stretches having a minimum width of 200 feet at the bottom. These stretches will be long enough to provide ample passage room for ships. The contract figure is $11,990,000 (£2,460,000), and it is stated that work is to be begun immediately.

The project has been "in the wind" for more than two hundred years, the dual object being to save time in the water passage between New York and Boston, and to avoid the heavy weather usually prevailing around Cape Cod. It is stated that the most dangerous part of the Atlantic coast of the United States, next to Cape Hatteras, is along this shore, on which twenty-three percent of the wrecks along the coast between Norfolk and Maine are said to occur, while long delays on account of fogs are frequent. It was formerly supposed that tide locks would be necessary, because of the fact that the tide at the Buzzards Bay end rises 8 or 9 feet, while on the Massachusetts Bay side the average rise is only from 4 to 5 feet. It is now stated, however, that the current set up by reason of this difference in elevation of tide, together with a difference in the time at which high tide occurs, will not be strong enough to interfere with navigation, or to cause serious scouring of the channel. Most of the work on the canal can be done by dredging through the sandy soil.

The inside water route between New York and Boston will be shortened by seventy miles, and the outside route by one hundred and twenty miles. The company which is financing the project will collect tolls for the use of the canal, but it is stated that these tolls will be but a small proportion of the expense which would be incurred by going around the Cape.



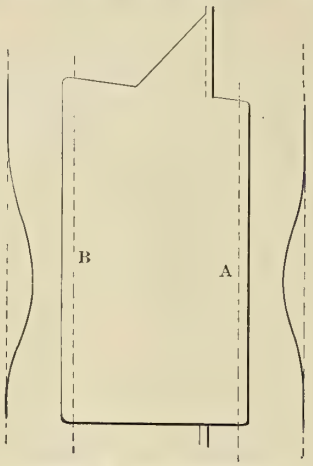
BOW VIEW OF NEW TYPE OF TORPEDO BOAT.

Recent Types of French Torpedo Boats.

BY J. PELTIER.

The French government has long pinned its faith on torpedo craft, both surface and submerged. There have recently been finished no less than seventy-two torpedo boats of the surface type, which have been built on the north and west coasts. The lines of these latest boats have been so designed as to make the vessels glide over the water as much as possible, instead of attempting to cut through it by main force. This gives them much better speed and seaworthiness than would otherwise be obtained.

The hull is of high tension steel, and is divided into six compartments by five watertight bulkheads. The first compartment is occupied by the crew; the second and third by boiler rooms, each containing one watertube boiler of either the Normand or Du Temple-Guyot type; the fourth compartment is the engine room, containing a triple-expansion three-cylinder engine, with auxiliary machinery, pumps, dynamos, etc.; the fifth compartment houses the officers and petty officers; while the last is the



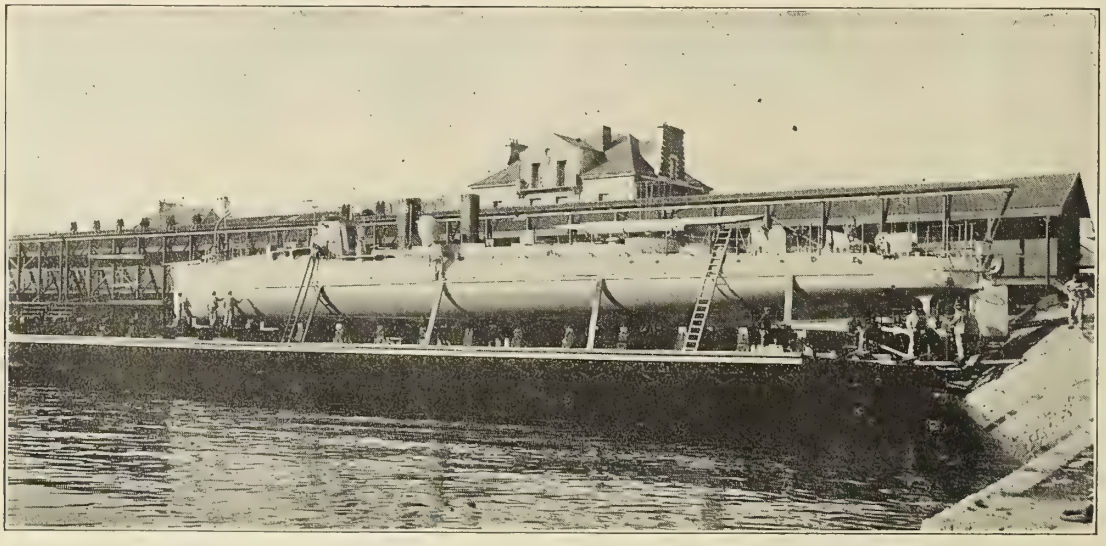
SKETCH OF NORMAND RUDDER.

store room. The conning tower forward is armored with 1-inch plates of nickel steel.

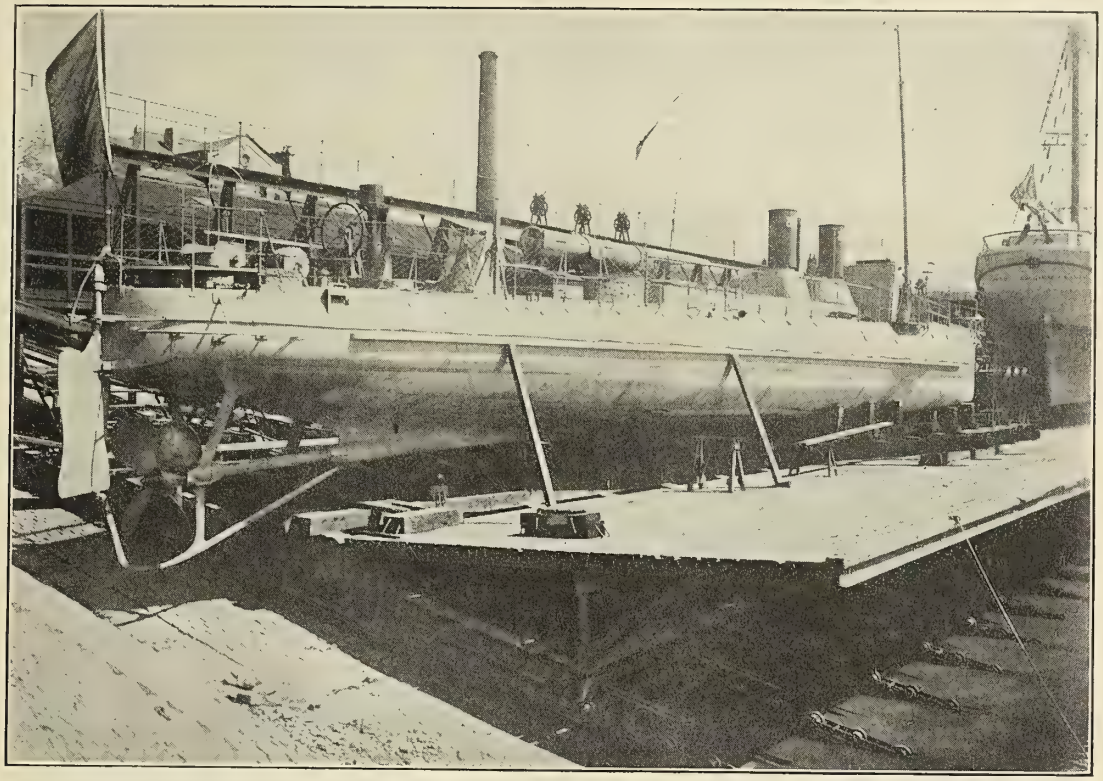
Formerly, twin-screw boats of 30 knots were constructed. It is now considered preferable, however, to build vessels with more regard to strength of hull and seaworthiness, and, as a result, the contract speed has been placed at 26 knots, there being only a single engine and screw. The armament consists of three torpedo tubes for 17.7-inch torpedoes, and two 1-pounder guns. Two of the tubes are on deck, about amidships, while the other is in the stem. Six torpedoes are carried.

A number of armored torpedo boats of 185 tons have been placed in service, the boiler and engine rooms being protected with 1-inch nickel steel plates on the sides and athwartship bulkheads. The armament of these vessels includes three 19-inch torpedo tubes and two 1.7-inch guns. There are twin screws operated by triple-expansion four cylinder engines.

An accident to one of these vessels shows the strength accruing from the armored sides. She was on her trial trip, and the steering apparatus went wrong. As a result the vessel ran at full speed upon a rock, the whole forward part being crushed. On examination in dry-dock, it was found that without this



FRENCH TORPEDO BOAT OF NEW TYPE HAULED OUT OF WATER FOR PAINTING.



VIEW SHOWING NEW TYPE OF RUDDER. THIS SHOWS ALSO THE METHOD OF RAISING THE BOATS FROM THE WATER.

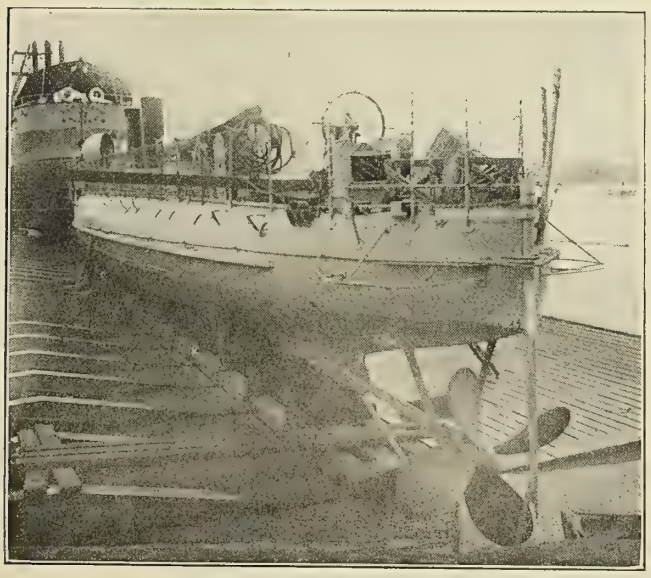
armored side the vessel would have been crumpled up completely and proved a total loss.

The rudders fitted on some of these vessels are of a peculiar type, designed by the late M. Normand. The sketch gives the general idea, which is further brought out in one of the photographs. The rudder is balanced, and of considerable size for such a small vessel. It will be noted, however, that instead of being a flat plate, there is a considerable bulge at both the forward and the after end of the rudder. It is said that when the vessel is steaming ahead, it is much more easy to steer with this rudder than with the ordinary type, when operating single screw boats. It is no longer necessary to shift the helm constantly, first to port and then to starboard, to balance the action of the water thrown from the propeller against the rudder.

The general dimensions of these vessels may be stated as follows:

	Torpedo Boat.	*Armored Torpedo Boat.*
Displacement in tons...	98.5	185
Length between perps..	124 ft. 8 ins.	147 ft. 8 ins.
Extreme beam.....	13 ft. 11 ins.	16 ft. 11 ins.
Depth	.. ..	11 ft. 8 ins.
Extreme draft, astern..	8 ft. 7 ins.	8 ft. 8 ins.
Horsepower	2,000	2,400
Trial speed, maximum.	27.4	28.7
Trial speed, minimum..	25.65	26.5

The smaller vessel has a bunker capacity of 11 tons, which is estimated to give a steaming radius at full speed of 200 nautical miles; and at a speed of 10 knots the radius is said to be 1,800 miles. With 900 horsepower, the speed is 14 knots at 179 revolution per minute.



STERN VIEW OF ONE OF THE NEW BOATS.

New Turkish Torpedo Craft.

BY DAGNINO ATTILIO.

On December 20, 1906, the seven Turkish destroyers, built by Ansaldo, Armstrong & Company, of Genoa, started for Constantinople with Italian crews.

The principal dimensions are:

Length between perpendiculars.....165 feet 6 inches.
Beam, extreme ..... 18 " 6½ "
Draft, mean ..... 4 " 3¼ "
Displacement .....165 tons.

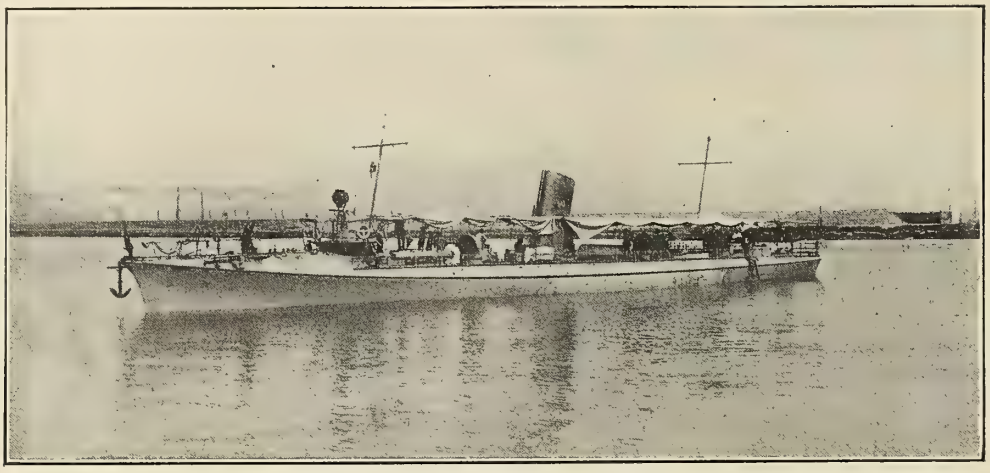
The destroyers are built of mild galvanized steel. There are nine watertight compartments, three of which are used for boiler and engine space, each fire room being fitted with watertight sliding doors. The compartment aft of the engine room is finished in hard wood, and is reserved for the officers' quarters; forward of the engine and boiler room are the petty officers' and crew's quarters. The flat keel plates are 5 millimeters (0.2 inch) thick, and the vertical keel plates are 4 millimeters (0.16 inch) thick. The frames are 20 inches between centers, and consist of angles 2 inches by ¼ inch in boiler and engine rooms. The general thickness of the deck plating is of 4 millimeters.

The armament consists of two torpedo tubes located on the

deck, one forward and one aft of the after conning tower. Each tube has a stowage case for one extra torpedo; also a portable crane and handling gear. Two 1½-inch rapid-fire guns are carried, one on each conning tower.

The vessels carry at their davits one whale boat and one folding boat of canvas. The bridge deck is at the level of the forward conning tower, and is fitted with steering wheel, compass and indicators to and from engine room. Above this is a platform for a 5,000-candlepower searchlight. The steering engine is located in the forward conning tower.

These boats attained a trial speed of twenty-six knots for one hundred minutes, according to contract.



TWIN-SCREW DESTROYER BUILT FOR THE TURKISH GOVERNMENT AT GENOA, ITALY.

SIDE VIEW OF THE STERN OF THE DESTROYER.

MACHINERY.

The engines are of the twin-screw vertical inverted three-cylinder triple expansion type, with cylinders 15¾, 24⅞ and 35½ inches in diameter, and 15¾ inches stroke. The collective horsepower of each boat is 2,400, when turning 350 revolutions per minute. Special care has been taken in design to secure minimum weight with maximum strength. The cylinders are of cast iron, and the covers and bottoms are of cast gun brass. Liners are not used, and there is no pipe communication between each cylinder and the next receiver. The pistons for intermediate-pressure and low-pressure cylinders are steel forgings, with followers of the same material. The ring for the low-pressure cylinder pistons is of cast iron, and held in place by steel springs, while the high-pressure and intermediate-pressure cylinder pistons are fitted with cast gun metal Ramsbottom rings. The high-pressure cylinder piston is a hollow casting of steel filled with lead, in order to obtain the same weight as the other pistons, and insure a balance of reciprocating parts, thus reducing vibration.

The framing is composed of ten forged steel columns, thoroughly braced with diagonal and other braces, and possessing great strength, combined with lightness. The guides are hollow castings of steel, fitted with a water service, the backing gibs being of forged steel. The crank shaft is made in one piece and not hollow, 5 9/16 inches in diameter. A small hole in the pins is utilized as an oiling device, the oil being thrown out by centrifugal force. The cranks are set at angles of 120 degrees.

The engines are fitted with single-ported piston valves for the high-pressure cylinders, and with Erick's valves for intermediate- and low-pressure cylinders, operated by slot links. The reverse motion is obtained by a right and left hand spiral sleeve,

THE STERN VIEW SHOWS EASY LINES.

worked by hand and steam gear. The bearings of the cross-heads, crank pins and other important parts are of naval standard composition, lined with anti-friction metal, and all fitted with automatic oiling devices.

The propellers are three-bladed, of manganese bronze, with a diameter of 5 feet 11 inches, and a pitch of 8 feet. The pitch ratio is 1.35; and the ratio between projected blade area and disk area is 0.3, the former being 8.25 square feet.

Each condenser is supplied with a separate condenser, built of copper and composition, and having a cooling surface of 1,894 square feet measured on the outside of tubes. The tubes are made of the same material, and tinned on the outside. The circulating water is supplied to them while the boat is in motion by a siphon through the hull, and by an independent engine and centrifugal pump when at rest. This pump is also utilized as a bilge suction is case of emergency.

The engine room is also fitted with a large boiler feed pump, delivering into a main pipe, which can be used to supply each of the two boilers; there are also two fire and bilge pumps. The bilge is also taken care of by a 2-inch steam ejector in each watertight compartment. The air pumps are driven by a small crank shaft coupled with key and screws at the fore end of the engine crank shaft. There are also a hot well pump and an auxiliary air pump worked by the centrifugal pump crank shaft. Evaporators are installed in the engine room, capable of supplying six tons of fresh water per hour, and there is also an electric plant of 5-kilowatt capacity, which furnishes light for the entire vessel.

BOILERS.

There are two boilers of the locomotive type, located forward of the engine room, and placed back to back. Each of these boilers has a grate surface of about 52 square feet and heating surface of 2,045 square feet (ratio 39.3), and is built for a working pressure of 200 pounds per square inch. The boilers are built entirely of Siemens Martin steel.

An auxiliary feed pump is fitted in each stoke hold, to deliver into an auxiliary feed pipe, and the system of piping is such that it is impossible to entirely disable the machinery through the breaking of a pipe. The boilers are fired under the closed fireroom system. There are two 63-inch blowers in each fireroom, each being run horizontally by a 6 5/16 by 4¾-inch single engine.

The bunkers are capable of carrying 60 tons of fuel.

New Italian Torpedo Boat Destroyers.

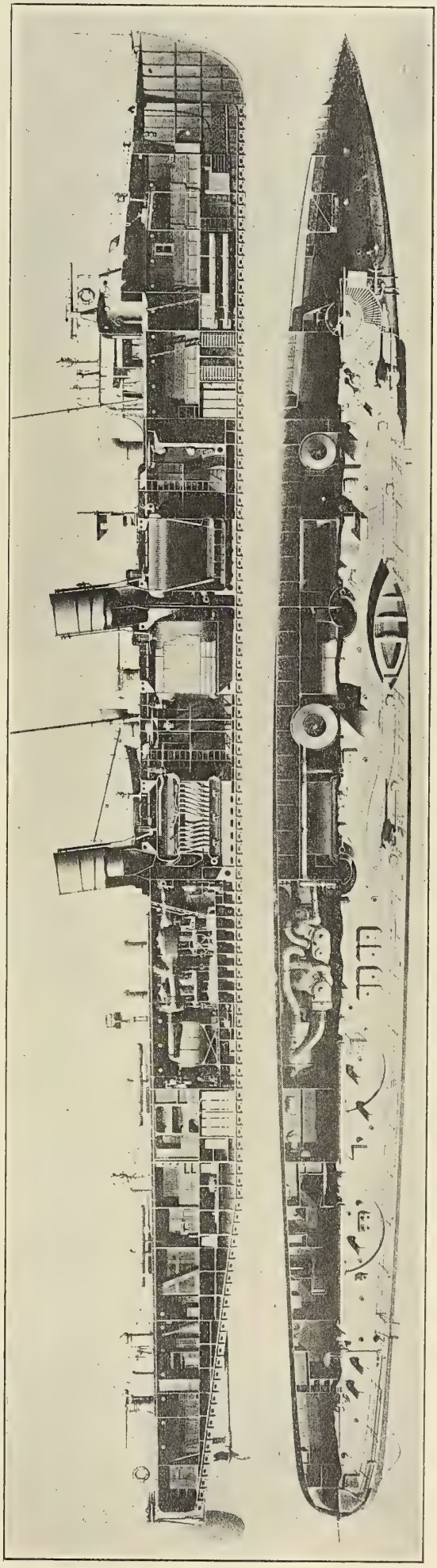
The Italian government has commissioned Messrs. C. & T. T. Pattison, of Naples, to build eight destroyers of the type constructed for the Japanese and British navies at Chiswick and Southampton by John I. Thornycroft & Co., Ltd. The plan and inboard profile of the *Nembo*, the first to be built, is shown. The *Espero* is one of the destroyers of this class.

These vessels are 210 feet long and have a beam of 19½ feet, the draft being 7½ feet. The power is supplied by triple expansion engines of the four-cylinder inclined condensing type. The stroke of these engines is 18 inches; the high and intermediate-pressure cylinders measure 22 and 29 inches in diameter, while the two low-pressure cylinders are each 30 inches in diameter. They developed 6,000 horsepower, with a boiler pressure of 220 pounds per square inch. The armament consists of one 12-pounder and five 6-pounder quick firing guns, and two torpedo tubes. All of the eight destroyers have been launched, and it is claimed all have attained a speed of at least 30 knots.

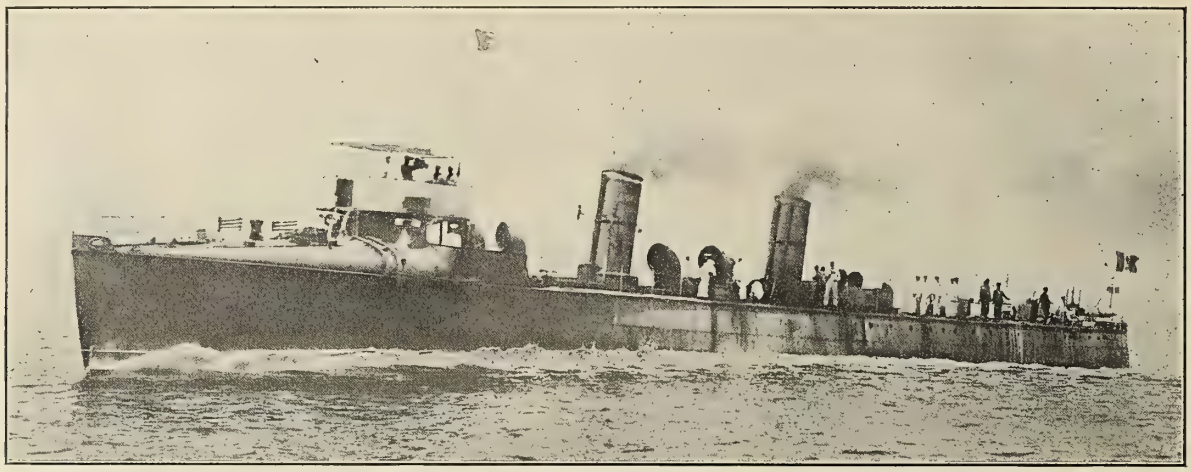
These shipbuilders are also building a half dozen stock Armstrong & Co., of Genoa, for four destroyers of the *Bersaglier* type, making 28½ knots with the engines developing 6,000 indicated horsepower. These boats have 53 men as the full complement, the same as the *Nembo* class.

These shipbuilders are also building a half dozen stock destroyers of this same class. The total length is 211 feet 6 inches; beam, 20 feet; and draft, 7½ feet. There are three Thornycroft boilers of the watertube type, as in the *Nembo*. The engines have a stroke of 18 inches, and cylinders 21, 28½ and two of 30 inches in diameter.

There is complete coal protection for the engines as well as for the boilers, the engines being echeloned, with a separate



LONGITUDINAL SECTION, HALF DECK PLAN AND HALF SECTION OF THE DESTROYER NEMBO. IT WILL BE NOTED THAT THE ENGINE CYLINDERS ARE OFFSET.



THE ITALIAN TORPEDO BOAT DESTROYER ESPERO STEAMING AT FULL SPEED ON HER TRIAL TRIP.

watertight compartment for each. The armament includes four 12-pounders and three torpedo tubes.

New English Torpedo Boat Destroyers.

The *Gadfly* is the first torpedo boat destroyer of a new class, designed for the British navy, and constructed at Chiswick, at the Church Wharf Works of John I. Thornycroft & Co., Ltd. This destroyer is 168 feet long, and has a maximum draft of 6½ feet with a beam of 17½ feet. There are four other boats of this class being built at the same yard. All are fitted with watertube boilers and Parsons steam turbines.

One of the interesting features of the steam generating equipment is the use of oil fuel, the Admiralty oil fuel apparatus being utilized. There are three shafts driven by steam turbines, each of the wing shafts taking one-quarter of the power, while the central shaft takes one-half of the entire power. On the center shaft are mounted both the astern turbine and the low-pressure turbine, while the cruising turbine for slow speed is also connected to the center shaft.

A speed of 27⅓ knots was obtained on a recent 8-hour trial, this being the mean speed, estimated in the usual way from a half dozen runs made on a measured mile at the Maplin Sands. These were taken on the fifth hour of the trial. The fuel oil consumed during the trial was 22.6 tons, which figures out at 1½ pounds of oil per horsepower per hour. It is stated that the steam pressure was maintained steadily throughout the trial, and as the boat became lighter the revolutions gradually increased. It is also said that as the oil tanks hold 40 tons, there was no reason why the trial should not have been continued until the whole of the fuel oil in the tanks was used up. An interesting feature of the trial was the perfect consumption of the oil, there being practically no smoke, and the funnels were quite cool.

Special trials were made in stopping, starting and going astern, as well as circle turning and steering, the results being found to be about the same as with the single screw torpedo boats. At two-thirds the number of revolutions required for the guaranteed speed of 26 knots, the boat was run astern for 15 minutes with the center propeller, and a run over the measured mile showed a speed of 12 knots. A speed of about 13 knots was shown on a run of 15 minutes, with the center shaft making 699 revolutions per minute.

The French Destroyer Claymore.

The destroyer *Claymore* has recently been delivered to the French government by the Normand Shipbuilding Company, of Havre. During the official trials, this boat attained a maximum speed of 30.356 knots, with a coal consumption which would have permitted her to run 1,170 miles at a speed of 14 knots. The propelling machinery includes two engines developing together 7,200 horsepower. There are two boilers, of the Normand type, each boiler giving the steam necessary for about 3,600 horsepower.

The displacement of the Claymore is 313 tons, and the weights carried on trials, comprising chains, anchors, masts, boats, torpedoes, torpedo tubes, compressing pumps, artillery and ammunition, provisions and water for boiler and crew, coal necessary for steaming 1,170 miles at 14 knots, crew and effects amounted in all to 93 tons.

The armament comprises two torpedo tubes, one 2.6-inch quick firing gun, and six three-pounders. The vessel has a

THE GADFLY IS ONE OF TWENTY-FOUR NEW COASTAL DESTROYERS, BUILT FOR THE BRITISH NAVY.

length on load line of 190 feet, and an extreme breadth of 21 feet 6 inches.

THE CLAYMORE, A TYPE OF TWENTY-FOUR NEW DESTROYERS BUILT AND BUILDING FOR THE FRENCH NAVY.

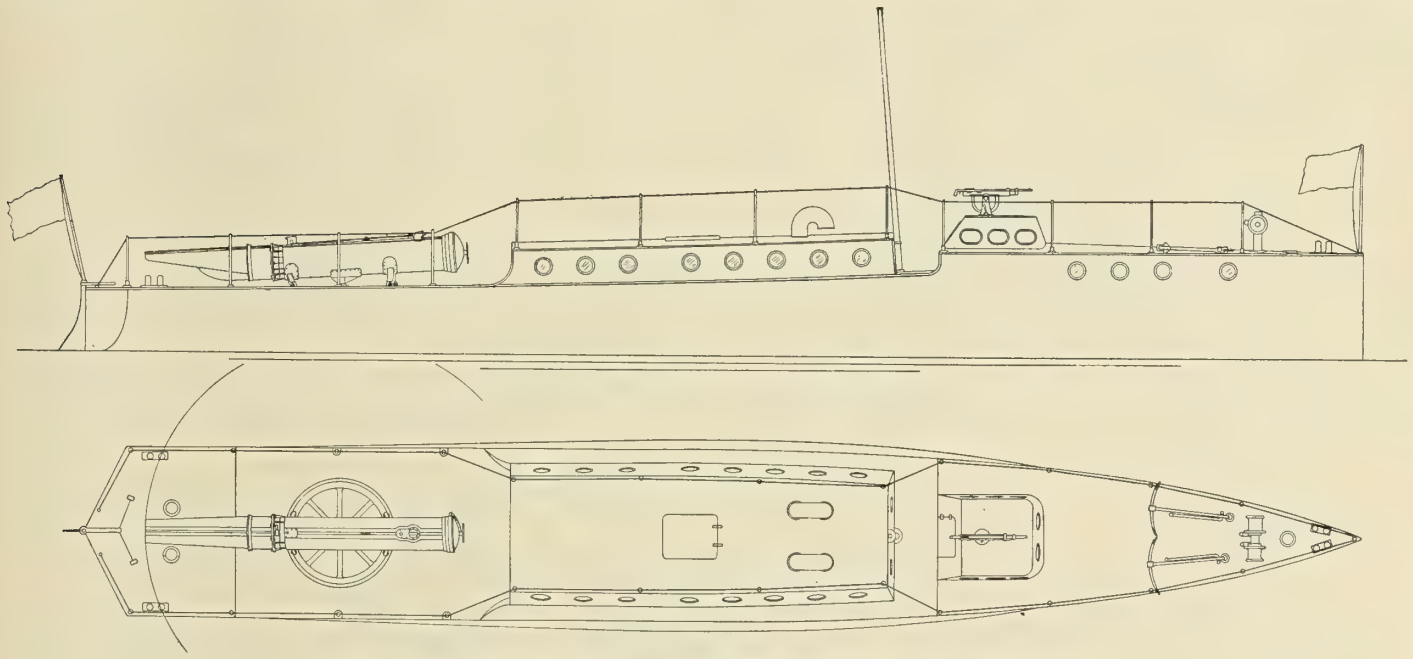
Notes on Motor Torpedo Launches.

BY C. T. BRADY, JR.

In the early days when the torpedo began to be seriously considered as an offensive weapon, and, due to Mr. Whitehead, an automobile weapon, students of its use advocated its adoption on small launches, capable of being carried on a ship's deck until there was need for them. But it was soon found that high speed could not be obtained with a small steam launch, and the enlargement of the boats began which has reached its present level in the 800-ton destroyers now building for the British navy.

While the steam pinnace carrying a tube has long been a part of many foreign navies, it has never gained much favor in our own—perhaps due to the fact that the two which were built for the old *Maine* and *Texas* proved to be such lamentable failures from the point of view of speed, the smaller one for the *Texas* doing only 11.3 knots on her trial in place of the 17 hoped for.

Of course the real reason for the failure of the steam launch is the impracticability of installing the power needed to get the desired speed without monopolizing weight which should properly be put into the rest of the boat; and also in that their engines are great coal consumers, especially in the small sizes used in the launches. In other words, steam sets are not light enough,

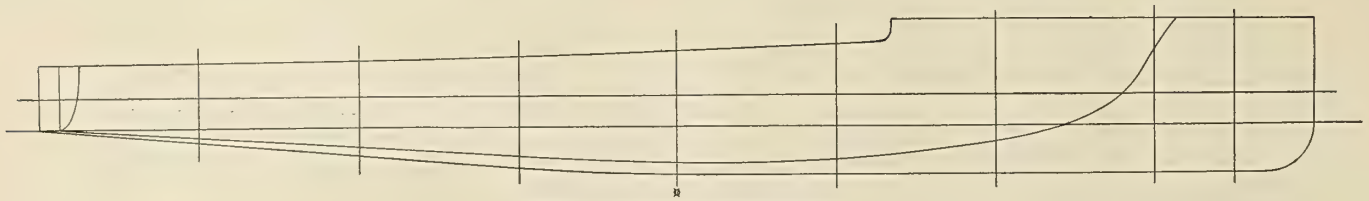


OUTBOARD PROFILE AND DECK PLAN OF PROPOSED MOTOR PROPELLED TORPEDO LAUNCH.

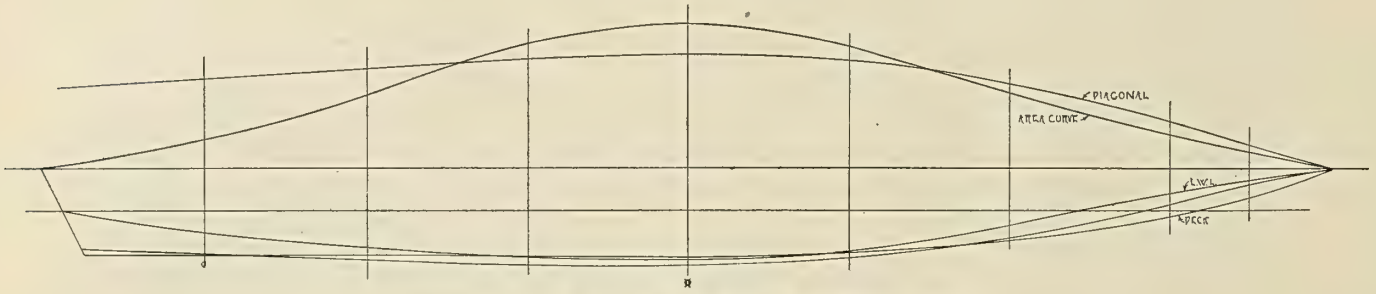
Naval experts have lately been reconsidering those early ideas, and the opinion is gaining ground that there may be a use for the torpedo launch after all. This opinion has received considerable force from the results of the battle of the Sea of Japan, wherein the Japanese torpedo boats, at the end of the day, rushed in and gave the final *coup de grâce* to the battered Russians. In this work the smaller boats were most efficient, as by reason of their small size they could creep in closer before being discovered. It is at this work that the torpedo launch may be expected to shine.

and burn too much coal per horsepower. It is to the internal combustion engine that we must turn to find power and lightness combined effectively. Its advantages over steam are many and varied, and have been frequently pointed out. It has also been tried practically with great success by Mr. Nixon in the Russian torpedo boats of the Black Sea, and by Mr. Yarrow in "1176," since bought by the British Admiralty.

Some of the advantages worth noting here are first of all its light weight, permitting small displacement for the same power, and hence greater speed. Since a steam engine requires a boiler



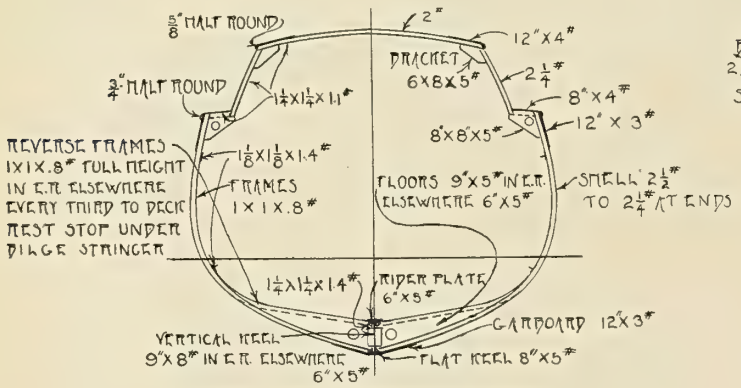
PROFILE, WITH ONE BUTTOCK LINE.



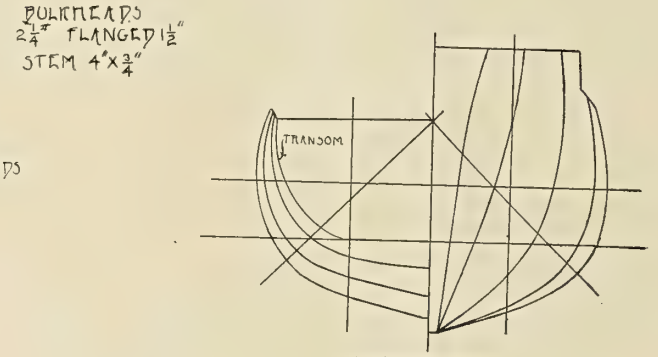
ABOVE-WATER LINES, DIAGONAL AND CURVE OF SECTIONAL AREAS.

and stokehold, the vital target in a small launch amounts to half the length or more. With a gasoline motor the target is reduced to about one-sixth of the over-all length, and the engine can be placed well forward, in the deep part of the hull, so as to gain the advantages of a long run with a small shaft angle. In addition to these reasons, which represent chiefly a saving of weight and space, it is found possible to install twin or even triple screw arrangements, which permit of great mobility and less liability of disablement, especially at the present high stage of development, when many engines show a regularity and steadiness equalled only by large steam outfits. Finally, there is the all important question of radius of action, wherein the explosive motor has at least twice the range of the usual steam engine.

The United States navy officials are considering this type of launch for use on the new battleships. Experience being rather limited, as many opinions as we can obtain on the subject will prove interesting and perhaps of value. The accompanying drawings seem to fulfil many of the requirements of this type.

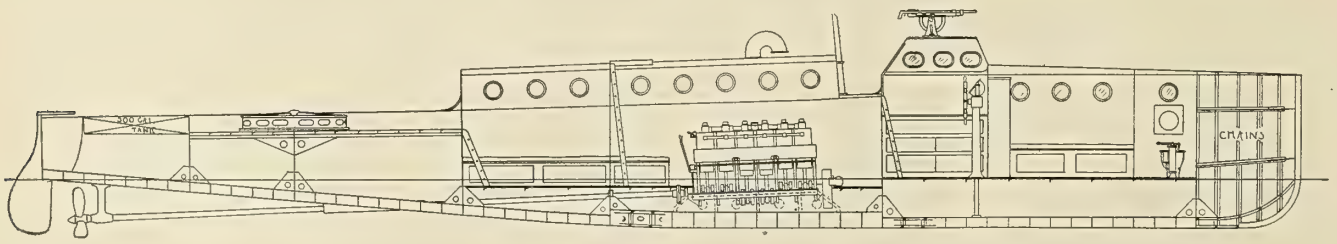


MIDSHIP SECTION, SHOWING SCANTLINGS.

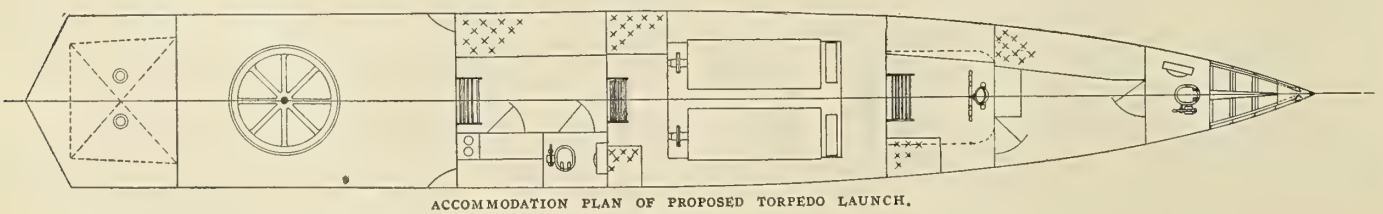


THE BODY PLAN.

The boat is sixty feet long, that being about the maximum which can be handled on a battleship's superstructure, and the weight has been kept down to twelve and a quarter tons, to permit of easy slinging. She could of course be made smaller by omitting one or both the cabins, but under certain circumstances these might be useful.



INBOARD PROFILE OF TORPEDO LAUNCH.



ACCOMMODATION PLAN OF PROPOSED TORPEDO LAUNCH.

For power the boat has two engines of 100 rated horsepower each, but which would undoubtedly develop 250 together, as this make of engine is underrated. At 550 revolutions per minute it is calculated that the speed would be at least 20 knots. With 300 gallons of gasoline, assuming a consumption of one-tenth gallon per horsepower hour, the radius would be nearly 300 miles at full speed, and at eleven knots about 800 miles, which would be utterly impossible for a steam launch of this size.

The boat would carry an 18-inch short Whitehead torpedo. In the drawing the regular deck tube is shown, as it does not seem that a practical boat should carry such poor substitutes as deck tongs or other dropping gear. The small automatic gun shown might be exchanged for a one-pounder rapid fire gun.

THE FRENCH SUBMARINE BOAT OPALE RUNNING AWASH.

As a matter of interest a table showing characteristics of several small torpedo boats is appended:

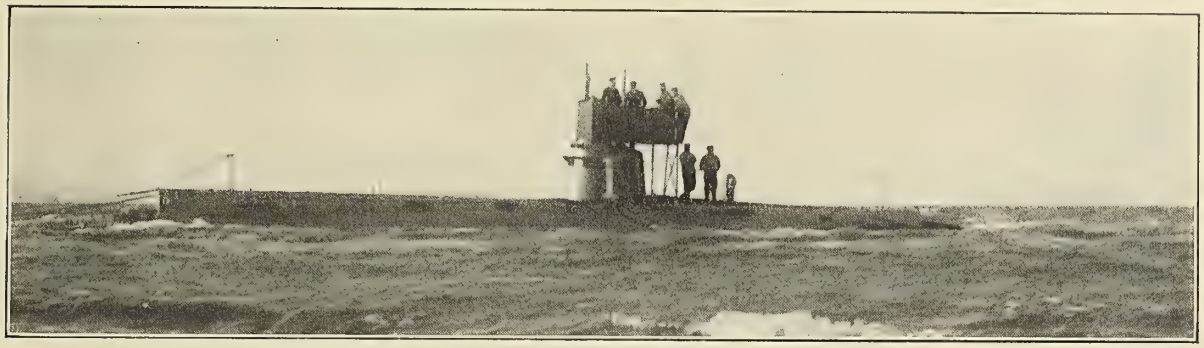
	Length feet.	Beam feet.	Draft feet.	Displ. tons.	H.P.	Speed knots.
Boat for *Maine*	58.5	9.0	3.0	19.9	220.7	12.6
Boat for *Texas*	48.1	9.0	3.7	15.2	158.5	11.3
Manly	60.6	9.3	2.9	20.0	.....	17.5
Nixon's Russian Boats	90.0	11.2	4.0	34.0	600.0	*20.0
Yarrow's "1176"	60.0	9.0	1.0	†8.0	300.0	**26.2
Proposed Launch ...	60.0	8.5	2.3	12.3	200.0	20.0

*Contract speed; said to have been easily exceeded.
†Weight of hull and engines only. Triple screw.
**World's record for this size, about 5.5 knots better than any steam torpedo boat of this size has ever done.

A New English Submarine.

The photograph illustrates *C-1*, the first of a new type of submarine built by Vickers, Sons & Maxim, Ltd., at Barrow. This vessel is fitted with two periscopes for observation when running submerged.

The boat has a length of 135 feet and a beam of 13 feet 6 inches, the displacement being 313 tons. The submerged speed for three hours is 8.5 knots. The maximum surface speed is 12.5 knots, at which speed the cruising radius is 950 nautical miles. At a speed of 9.5 knots on the surface this radius becomes 1,350 miles. Two tubes are fitted for 18-inch Whitehead torpedoes. The propulsion is by a single screw engine actuated by gasoline when on the surface, and by electricity when below.

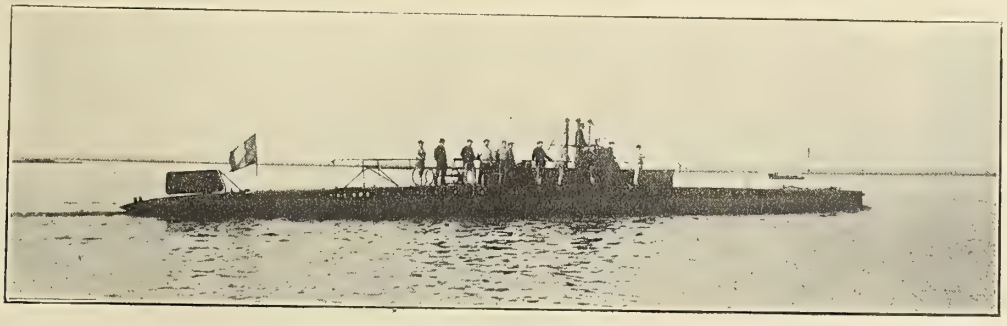


THE ENGLISH SUBMARINE C-1, DURING A TRIAL RUN AWASH.
(Photograph, Stephen Cribb, Southsea.)

French Submarines.

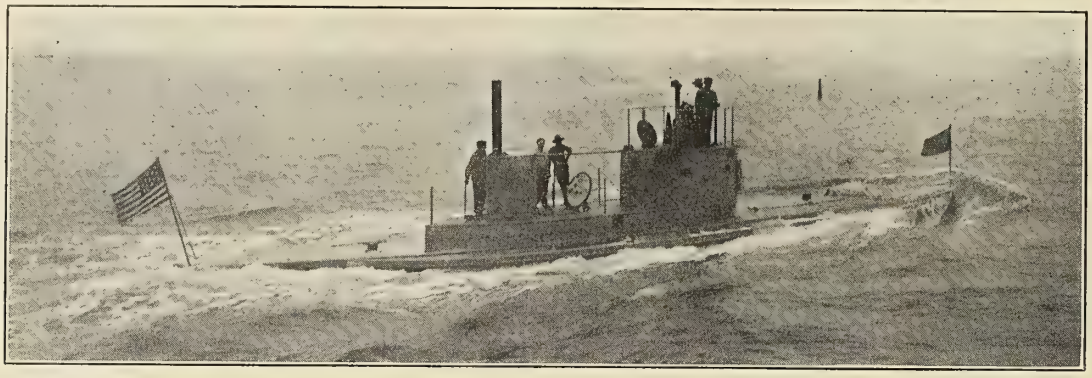
Among the latest underwater boats laid down for the French Navy is the submersible *Cigogne*, which measures 175 tons afloat and 250 tons submerged. This vessel has a length of 118 feet, a beam of 12 feet 9 inches and a draft afloat of 9 feet. She is driven by twin screws, actuated by kerosene engines of 200 horsepower when afloat and by electric motors when submerged. The maximum speed is 12 knots, and four torpedoes are carried. This is said to be the type preferred by Admiral Fournier of the French navy.

The *Opale*, which was laid down in 1903, is said to be the largest submarine afloat. Her displacement is 390 tons awash and 430 tons submerged. The length is 147 feet; the breadth, 12 feet 9 inches; and the draft, afloat, 12 feet 1 inch. A maximum speed



THE FRENCH SUBMERSIBLE CIGOGNE.

of 12 knots is obtained with twin screws operated by kerosene engines of 600 horsepower when afloat. Electricity is used for propulsion submerged. Six torpedoes are carried.



SUBMARINE BOAT LAKE, OF THE LEVEL KEEL TYPE, IN NEW YORK BAY.

The Submarine Boat Lake.

In Newport harbor, tests have recently been conducted, in which the United States submarine *Octopus* and the level keel boat *Lake* have been competitors. The latter vessel is said to have made an average speed of 8.6 knots awash, and 7.68 knots when run with her gasoline (petrol) engines alone, no assistance being derived from the stored energy in her storage batteries.

Lloyd's Report on Ship Construction.

Under date of March 31, Lloyd's Register reports under construction in the United Kingdom 585 merchant vessels, aggregating 1,306,087 gross tons, as compared with 547 vessels of 1,401,882 tons a year ago. The total warships under construction in the United Kindom are given as 55, of an aggregate of 248,520 tons, of which seven are building in royal dock yards, and the remainder in private yards. Seven of the total are for foreign owners, the remaining forty-eight being British. The report shows merchant vessels under construction in other parts of the world as follows:

United States, excluding Great Lakes	87	158,827 tons.
Germany	79	198,690 tons.
France	30	83,506 tons.
Italy	23	70,883 tons.
Japan	17	64,990 tons.

Two steam turbine fireboats for the city of New York were launched April 16 at the yards of Alexander Miller & Bro., Newburg, N. Y. They will be similar in construction, the length on deck being 131 feet, breadth of hull 27 feet, and depth 14 feet. The engines will be turbines of 830 horsepower. The pumps, of the new centrifugal pattern, will be driven directly by turbines, and each will have a capacity of 10,000 gallons of water per minute. There are to be no obstructions on the decks, which are to be flush and always clear for action. The only objects on deck will be the pilot house forward, the funnel amidships, the watertower aft and the two turrets for hose connection. There will be nine 3½-inch hose connections in each turret. Another boat is in hand.

Development of the Cunard Line.

A neat little booklet has been issued by the Cunard Steamship Company which gives a pictorial history of the development of the line through the various stages represented by the wooden paddle steamer *Britannia* of 1840, the iron paddle steamer *Scotia* of 1862, the iron screw steamer *Russia* of 1867, the steel screw steamer *Aurania* of 1882, the twin screw steamer *Campania* of 1893, the triple screw turbine steamer *Carmania* of 1905 and the new leviathans of 1907. The illustrations are in colors from paintings, each left-hand page being devoted to a description of the vessel shown on the right.

POINTS OF INTEREST IN CONNECTION WITH THE DESIGN, BUILDING AND LAUNCHING OF THE LUSITANIA.*

BY W. J. LUKE.

HIGH TENSILE STEEL.

A few details of the mean results of the experiments undertaken to ascertain the relative merits of the different materials may be given. It is quite apparent that, although the ordinary mechanical tests can be readily enough carried through in the test house at a steel works, tests for discovering the elastic limit (or even the breakdown point) are much more difficult and tedious. When it is considered that either of these points is reached when the extension of the specimen is probably less than 1-100 inch in a length of 6 inches, it is quite evident that any attempt to discover this limit by means of marks, no further apart than the above distance, and on pieces in process of testing to destruction, must be quite out of the question.

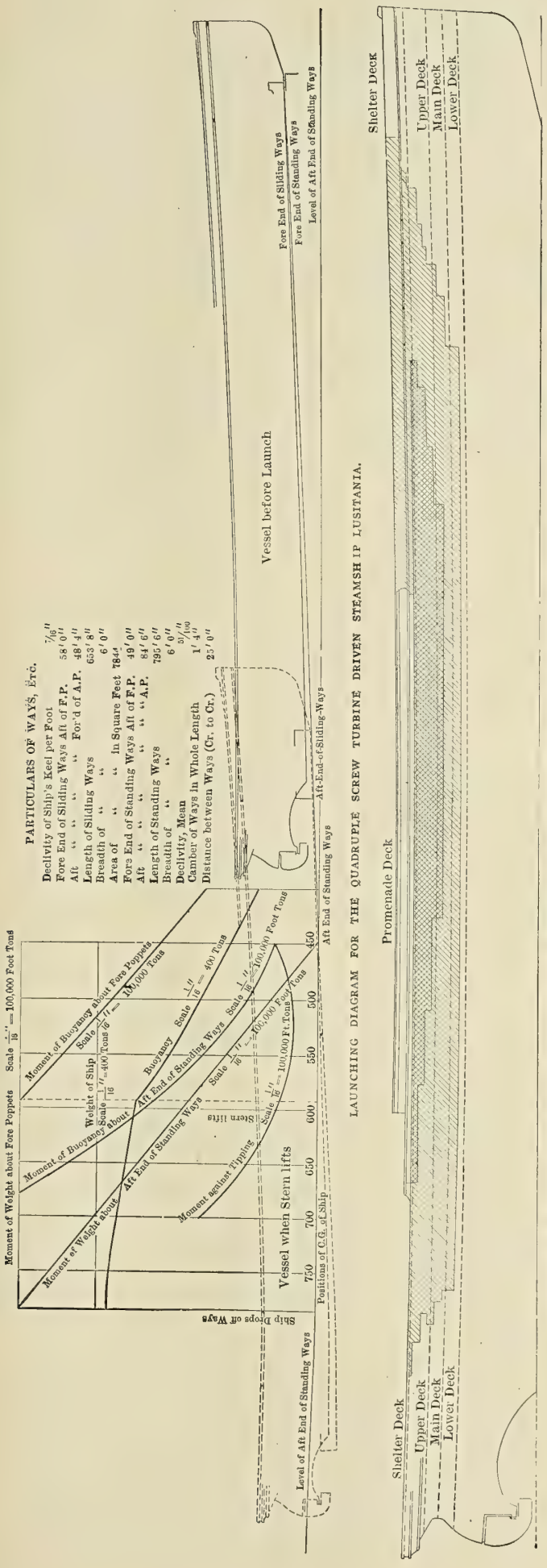
These tests were accordingly made by David Kirkaldy & Son, London, on specimens 11 feet long by 2 inches broad, and of thicknesses varying from 0.737 to 1.515 inches. This insured absolute impartiality in the conducting of the tests, and the results incidentally furnish complete proof (if such were needed) that if elastic limit is defined as the limit over which stress and strain are directly proportional, there is hardly any stress, however low, which can be called the elastic limit. The results given are the mean of those given by two specimens of mild steel; ten specimens of high tensile, normal; and eleven specimens of high tensile, annealed. The third series is given, although the ship plates used in the construction were not annealed. It should also be noted, in connection with the ultimate extension, that it is measured over a length of 100 inches, and, in consequence, the percentage extension is much less than in a specimen of 8 or 10 inches length. This is due to the fact that in all these lengths of specimens the local extension at the fracture would be the same.

MEASUREMENTS TAKEN OVER AN ORIGINAL LENGTH OF 100 INCHES.

Material	Ultimate Extension in. and %	Elastic Stress tons per sq. in.	Ultimate Stress tons per sq. in.	Ratio of Elastic to Ultimate Stress
Mild Steel	17.65	12.9	29.6	43.5%
High Tensile Steel, normal	13.64	17.5	36.8	47 7%
High Tensile Steel, annealed	14.80	19.5	36.6	53.4%

In the strength calculation, it was assumed, and so specified to the makers, that mild steel should have an ultimate tensile strength of from 28 to 32 tons per square inch of original sectional area, and high tensile steel, free from nickel, and not

*Read before the Institution of Naval Architects, March 21, 1907.


PARTICULARS OF WAYS, ETC.
Declivity of Ship's Keel per Foot 7/8"
Fore End of Sliding Ways Aft of F.P. 58' 0"
Aft " " " " For'd of A.P. 48' 4"
Length of Sliding Ways 653' 8"
Breadth of " " 6' 0"
Area of " " In Square Feet 7844
Fore End of Standing Ways Aft of F.P. 49' 0"
Aft " " " " " A.P. 84' 6"
Length of Standing Ways 795' 6"
Breadth of " " 6' 0"
Declivity, Mean 5/100
Camber of Ways in Whole Length 1' 4"
Distance between Ways (Cr. to Cr.) 25' 0"
Vessel before Launch
Fore End of Sliding Ways
Fore End of Standing Ways
Level of Aft End of Standing Ways
Aft End of Sliding Ways
Aft End of Standing Ways
Shelter Deck
Upper Deck
Main Deck
Lower Deck
Promenade Deck
Moment of Weight about Fore Poppets Scale 1/16" = 100,000 Foot Tons
Moment of Buoyancy about Fore Poppets Scale 1/16" = 100,000 Foot Tons
Weight of Ship Scale 1/16" = 400 Tons
Moment of Buoyancy Scale 1/16" = 400 Tons
Buoyancy Scale 1/16" = 400 Tons
Moment of Weight about Aft End of Standing Ways Scale 1/16" = 100,000 Foot Tons
Moment of Buoyancy about Aft End of Standing Ways Scale 1/16" = 100,000 Ft. Tons
Moment against Tipping Scale 1/16" = 100,000 Ft. Tons
Stern lifts
Vessel when Stern lifts
Positions of C.G. of Ship
Ship Drops off Ways
Level of Aft End of Standing Ways
400
450
500
550
600
650
700
750

LAUNCHING DIAGRAM FOR THE QUADRUPLE SCREW TURBINE DRIVEN STEAMSHIP LUSITANIA.

ELEVATION OF HULL OF LUSITANIA, SHOWING HIGH TENSILE PLATING CROSS-HATCHED ONCE AND HIGH TENSILE DOUBLING PLATING CROSS-HATCHED TWICE.

annealed—such as was used in the construction of the ship—should have an ultimate tensile strength of from 34 to 38 tons, an increase of 20 percent. The normal high tensile steel is here shown to be above expectation as regards ultimate tensile strength by 2.2 percent and above the mild steel by over 24 percent. Taking, however, the expected increase of 20 percent, and with an increase of 9.7 percent in the ratio of the elastic limit stress to the ultimate tensile stress, we may say that the high tensile material is 32 percent better than the mild steel. If we take the increase for tensile strength as 24 percent and for elasticity as 9.7 percent, it shows a superiority of 36 percent.

The specimens had 25 spaces of 4 inches each, marked off along their lengths, and extensions were measured at increments of one ton load per square inch of original sectional area, and the ultimate extensions over the 4-inch spaces were recorded. These latter gave a measure of the uniformity of the strength of the material, while by the former the yield point or limit of elasticity was gaged. This seems to have been considered as reached when a permanent set of about 0.01 percent of the original strength took place.

It was also stipulated that, besides having tensile strength as mentioned above, the high tensile steel should be able to satisfy all the other mechanical conditions and tests applied to mild steel. The elongation on a length of 8 inches, and on 8-inch specimens, was sometimes as high as 30 percent, and never below 23 percent, which compares very well with the specified minimum of 20 percent in mild steel. The non-temper test had to be satisfactorily met, and bending tests were conducted on 11-foot specimens of mild and high tensile steel, and they were found to be of about the same value for withstanding flexural stresses. A series of percussion tests clearly demonstrated the superiority of the high tensile steel to the mild steel with which it was compared, and the material was consequently accepted. As will be gathered from the previous mention of the positions in which it has been used, no furnacing or bending of plates was required. It was considered advisable to drill all the holes in these plates, and to trim up all edges in the planing machine, planing off a breadth (or length) equal at least to half the thickness of the plate in question.

LAUNCHING.

Before the keel blocks of this vessel were laid, calculations had to be undertaken to see that she could be safely launched. The line of the berthing was selected to suit the length of the ship, and so that her stern might point to the River Cart at its confluence with the Clyde. Suitable declivities of keel blocks and launching ways were determined by a limited process of trial and error until, corresponding to certain declivities with practicable heights of blocks a safe margin of moment against tipping was assured, and the vessel did not commence to lift until she was far down the ways. These declivities, as stated before, were 7-16 inch for the keel blocks, and 51-100 inch for the ways. The minimum excess of moment against tipping was 22 percent of the moment causing tipping at that place, and lifting occurred at 75 percent of the run down the ways.

When a stern lifts, owing to the excess of buoyancy over weight at the aft end, as the total weight is greater than the buoyancy, there is left an unbalanced weight to be taken on the fore poppets, and communicated through the ways to the ground. The shorter the length of ways over which this weight is borne, the more intense will be the rate of pressure; if the poppets were rigid, this thrust would be located at the extreme forward end, and it is only by the yielding of the struts that this load is distributed. In the *Lusitania* this was facilitated by the fitting of soft wood packing under the poppets. This packing at the fore end was 6 inches thick, and compressed 1⅝ inches, and the struts themselves would also compress or crush, and so distribute the load.

A factor in the safety of a launch is the length of time the vessel has to run after the stern lifts until she drops or floats off

the ways. This is especially so with long ships, as they are more liable to be canted by the action of the tide, wind, or drags. In case this happens, it tends to cause the poppets to trip, and the fore end of the vessel to come down on the ground. The difference between weight and buoyancy can be calculated at any stage of the vessel's progress down the ways, and, if the center of gravity of the vessel be known, and the center through which the buoyancy acts, the center of pressure on the ways can be found by proportion. Knowing the weight that the ways are supporting $(W—B)$, and the surface affording this support, the mean rate of pressure can be obtained at any position of the ship on the ways. These mean pressure rates are shown.

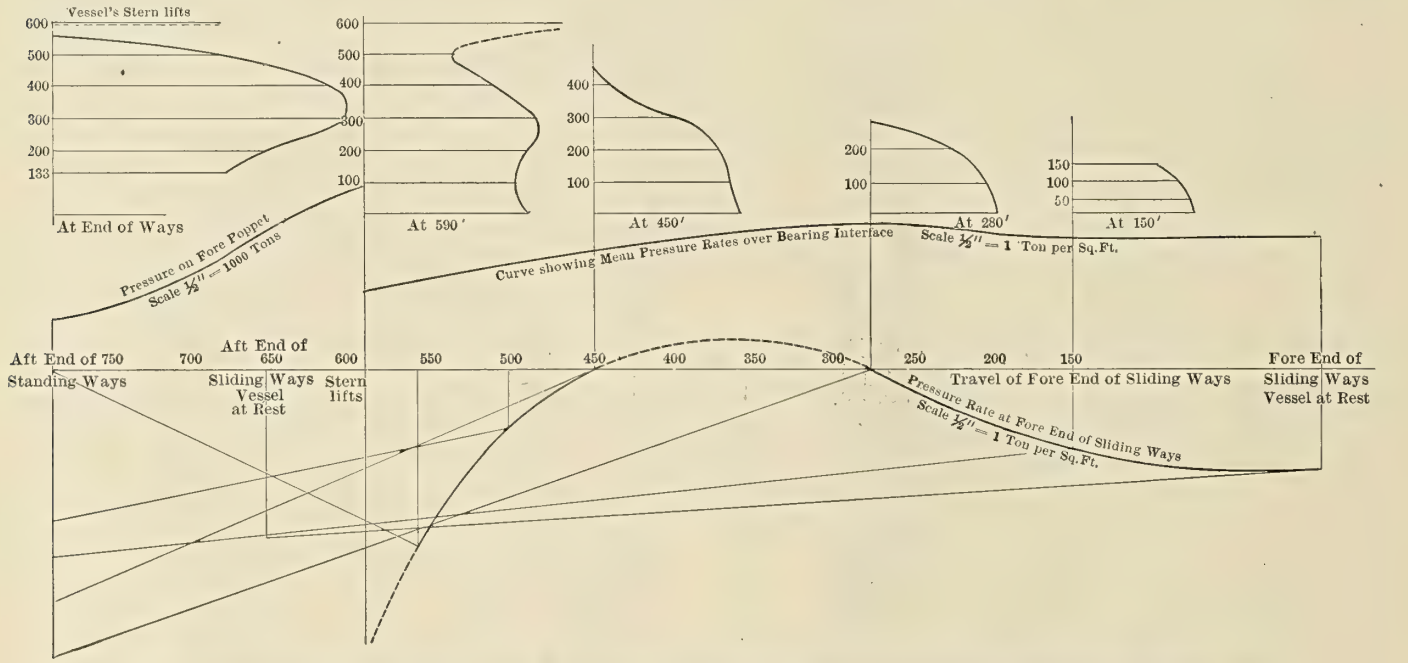
Now, if the center of the pressure is not at the mid length of the supporting surface, the rate of pressure over this surface cannot be uniform. If, however, we assume that its variation is uniform, the curve of rates of pressure over the supporting length would be straight, and the slope can be obtained from our knowledge of the position of the center of pressure.

If x be the distance of the center of pressure from the aft end of the standing ways, and h the distance from the after end of the standing ways to the fore end of the sliding ways, and p the mean pressure rate over this distance, we can determine a and b (pressure rates at fore end of sliding ways, and after end of standing ways, respectively) from the formula $x = h\left(\frac{2a+b}{3a+3b}\right)$ from which, since $p = \frac{a+b}{2}$, $a = \frac{6px}{h} - 2p$, and $b = 4p - \frac{6px}{h}$. Now, if $x = \frac{h}{3}$, b will be zero; this is a case not likely to occur in fine ships. If $x = \frac{1}{3}h$, a will be zero, and if x is less than $\frac{1}{3}h$, a will be negative, which means that there will be an upward pressure at a.

The figure has as base the distance the vessel has traversed, and shows the corresponding mean rate of pressure over the ways; also, the rates of pressure over the ways proportioned according to the above formula. This shows that when the *Lusitania* had run 280 feet, there was no pressure at the fore end of the ways, and the same occurred at 450 feet run. Between these two, the pressure at the fore end of the sliding ways tended upwards, and the amount of this tendency is shown by the curve. From where the stern lifts until she leaves the ways the curve of total pressure on the fore poppets is shown.

The variation of mean pressure rates, as shown by the diagram, is very slight, being about two tons per square foot, from the start until the ship has run 350 feet. The pressure rates at the fore end of the sliding ways vary during this distance from 1.5 tons per square foot positive to a slight negative pressure, and the corresponding pressure rates at the after end of the standing ways vary from 2.5 to 4.66 tons per square foot positive. This is a much more intense rate of pressure than is apparent by merely considering the mean pressure over the length of the ways, and the tendency to upward pressure experienced at the fore end of the sliding ways has not to my knowldge been demonstrated before.

Fortunately this intense pressure rate at the after end is prepared for by the means taken to withstand the high pressure on the ways when the vessel lifts at the stern. The pressure amounted to 19 percent of the launching weight at the time of lifting in the *Lusitania*, and, if taken as distributed over the fore-length of sliding ways, gives a mean rate of 10 tons per square foot. This mean rate could in turn be allocated to the ends of the length of sliding ways over which it is distributed, and in all probability would be augmented at one end and diminished at the other, in the same manner as was found in distributing the pressure over the total length of sliding ways.



CROSS CURVES SHOWING VARIATIONS OF RATES OF PRESSURE AT POSITIONS INDICATED, FOR ALL POSITIONS OF THE SLIDING WAYS.

Curves are also shown indicating the variation in the rates of pressure that come on various parts of the sliding ways as the ship passes over them. They are set off in terms of the distance the vessel has run. Of special interest is the one at 590 feet down the ways, the locality in which the fore ends of the sliding ways are when the vessel lifts; also the one at the after end of the standing ways.

As is well known, the ship was successfully launched on June 7, 1906; the total time which elapsed from the release of the triggers until she was fully afloat was 86 seconds; of this period 22 seconds were absorbed in tripping the keel blocks left under her, and in this operation she progressed only about one foot down the ways. This gives an average speed of 12.2 feet per second for the remainder of the journey to the water. The velocity was so moderate that the vessel was brought up with

her bow about 110 feet from the shore, the total weight of drags in use having been 1,000 tons.

CALCULATION FOR MOMENT OF INERTIA.

Item.	Area in sq. in.	Lever in feet.	Moment sq. in. × ft.	Moment of Inertia. sq. in. × sq. ft.
Below assumed axis, 27 feet above base:				
Flat plate keel	76 8	26.9	2 066	55 783
Bottom and side plating	908.4	20.6	18,713	385,488
Center keelson	46.8	24.5	1,146	28,090
Side girders	138.0	23.9	3,298	78,827
Tank top and margin plate	429.4	21.6	9,275	200,340
Continuous side girder	39.6	23.9	946	22.620
Side stringers	55.2	6 9	381	2,628
Bunker side	110.9	8.1	898	7.274
	1,805.1		36,723	781,050
Above assumed axis, 27 feet above base:				
Side plating	662.2	20.0	13,244	264,880
Lower deck	173.6	6.6	1 143	7,543
Main deck	185.9	14.6	2.714	39,624
Upper deck	291.6	23.6	6.882	162,415
Shelter deck	480.4	34.1	16,382	560,265
Bunker side	43.2	3.4	148	508
Casing bars	17.2	24.2	417	10.091
	1,854 1		40,930	1,045 326
Deduct one-sixth for rivets	309.0		6,822	174,221
Above 27 feet	1,545.1		34 108	871,105
Below 27 feet	1.805.1		36 723	781.050
	3.350.2		2,615	1,652,155
Neutral axis 0.78 feet below 27-foot line, *i. e.*, 26.22 feet.		Correction..		2,043
Lower lever, 26.30 feet. Upper lever, 35.53 feet.				1,650,112 2
		Total moment of inertia.....		3,300,224

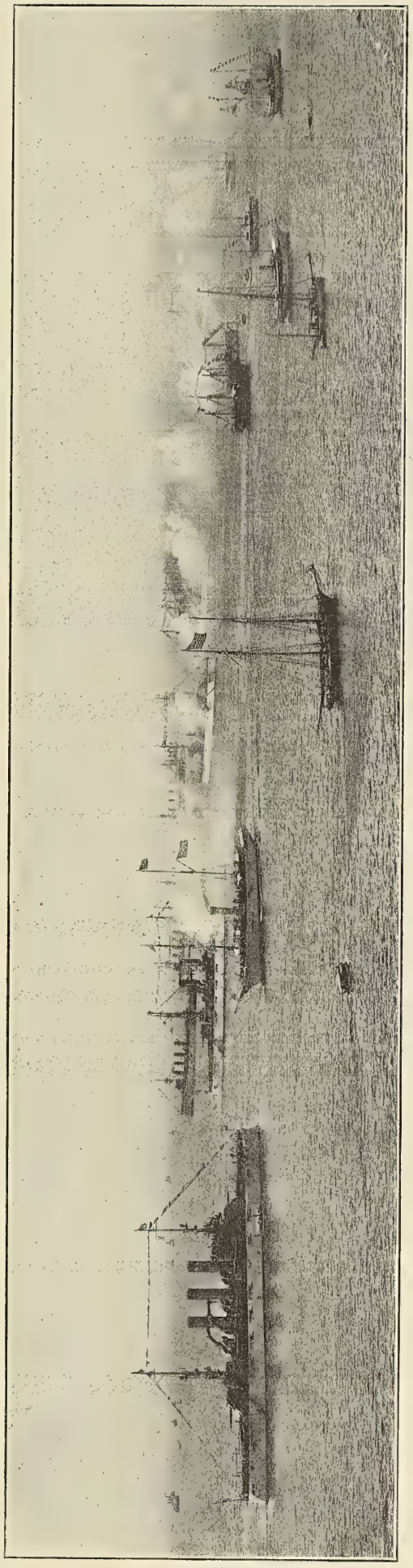
In round figures, the moment of inertia in units of square inches × feet squared is 3,300,000, and the bending moment, in the condition when entering port, is 1,020,000 foot-tons. The consequent stress per square inch on the shelter deck—in extension—is 10.6 tons, and the compressive stress on the keel is 7.8 tons.

The Naval Review in Hampton Roads.

On April 26 there took place in Hampton Roads, in connection with the official opening of the Jamestown Exposition, a naval review in which participated thirty-eight American ships and nine from other navies. Owing to a change in the date of the opening of the exposition the contingent of foreign ships was not so large as was expected, and a number of the vessels have arrived on the scene since the review took place.

The American ships present at the review included sixteen first class battleships, four armored cruisers, three coast defenders, one protected cruiser, six torpedo destroyers, five torpedo boats, and three auxiliary vessels. The foreign contingent actually present included four British armored cruisers, two German cruisers, two Austrian cruisers and one Argentine cruiser. The vessels which did not arrive in time for the official opening included two French armored cruisers; two Italian cruisers; one Japanese cruiser and one battleship, the former having been built in the United States and the latter being the first ship of its class built in Japan; three Brazilian ships; one Chilian cruiser and one Portuguese cruiser.

Our photograph shows the *Georgia* at the extreme left. Back of the *Mayflower,* which appears in the center of the picture, is the *New Jersey.* Next along the ships in the line to the right are the *Rhode Island* and *Virginia.* These four battleships are sisters, of nearly 15,000 tons, and have a speed of 19 knots and very powerful batteries. The second line in the photograph, showing in the background, begins with the British cruiser *Roxburgh,* after which come the *Hampshire, Argyll,* and *Good Hope.* The smoke from the saluting guns is so thick that only portions of the other vessels present can be seen, but enough



VIEW OF THE NAVAL PAGEANT IN HAMPTON ROADS, AS THE MAYFLOWER IS ABOUT TO TURN THE HEAD OF THE AMERICAN COLUMN, WHICH CONTAINED SIXTEEN BATTLESHIPS.
(Copyright 1907, by C. L. Chester.)

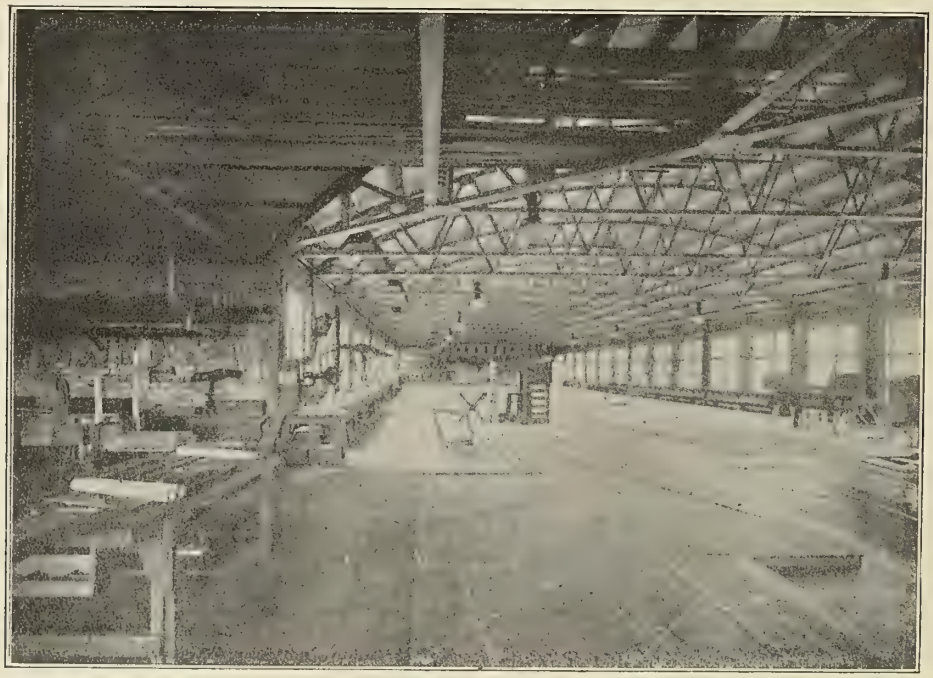
is visible to show the great extent of the squadron assembled, the line having been about four miles long. One feature to be noted in connection with the illustration is the lining up of sailors along the rails of the American and British ships. The men were arranged in solid lines from bow to stern, and on certain portions of the superstructure. The illumination at night was an especial feature, all of the ships being outlined by incandescent lights. The American ships had their names spelled in "letters of fire" across each bridge.

GENERAL VIEW OF THE CLYDEBANK YARD OF JOHN BROWN AND COMPANY, LIMITED.

JOHN BROWN & COMPANY'S SHIPYARD.

In 1899 John Brown & Company, Limited, of Sheffield, long known as manufacturers of armor and large forgings of all sorts, acquired the Clydebank Shipyard, established on the Clyde near Glasgow in 1873. This establishment covers an area of eighty acres, and is equipped with facilities for constructing ships of all sorts, from the smallest size up to the biggest afloat. Large numbers of vessels, both warships and mercantile, have been constructed at this yard, prominent among which might be mentioned the *City of New York* and *City of Paris*, now the *New York* and *Philadelphia* of the American Line; the *Saxonia* of the Cunard Line, which was notable mainly for the great economy in operation; the steam yacht *Mayflower*, now forming a part of the naval establishment of the United States; and culminating with the *Lusitania* of the Cunard Line, which was launched a year ago. Many of the large cruisers of the British navy have come from this yard, the latest war vessel being the new battle cruiser *Inflexible*, of 17,250 tons.

The establishment is situated on the north bank of the river, and has been laid out on a liberal scale in order to provide room for expansion. Since it has come into possession of the present owners, a large amount of work has been done in the shape of fitting out new building berths and constructing new machine shops. The general arrangement includes six shipbuilding berths in what is known as the east yard, and several in the extension towards the west. Between these two series is an open dock for fitting out vessels after they are in the water. Angle iron departments, beam and plate scrieve boards, furnaces and machine tools are arranged at the head of each series of berths. The carpenters, joiners, cabinet makers, polishers and woodworking departments generally are in the east yard,



THE MOLD LOFT MEASURES 250 FEET IN LENGTH BY 55 FEET IN WIDTH.

contiguous to both the dock and the building slips. In both sections of the works are smith shops, forges and light iron shops.

The engineering and boiler works are placed at the end of the fitting out dock, being thus not only close to the vessels where machinery is being fitted on board, but also equidistant from the two series of shipbuilding berths. It is thus a simple matter to convey by the yard railway the machinery and boilers in parts to any ship, either on the ways or in the dock. The engineering section includes also a large smith shop, brass foundry, copper shop and galvanizing department.

The frontage of the works on the Clyde is 3,200 feet. The various building berths have lengths varying from 450 to over 800 feet. Several of them have been constructed to support the concentrated weights due to the modern battleship and cruiser, the unit weight per square foot of surface carried by the launching ways amounting in some cases to as much as 3 tons. The waterway in front of the yard is such as to make it possible to float the largest liners, the building berths in the east yard converging upon the center of the river Cart, which flows into the Clyde almost directly opposite the works.

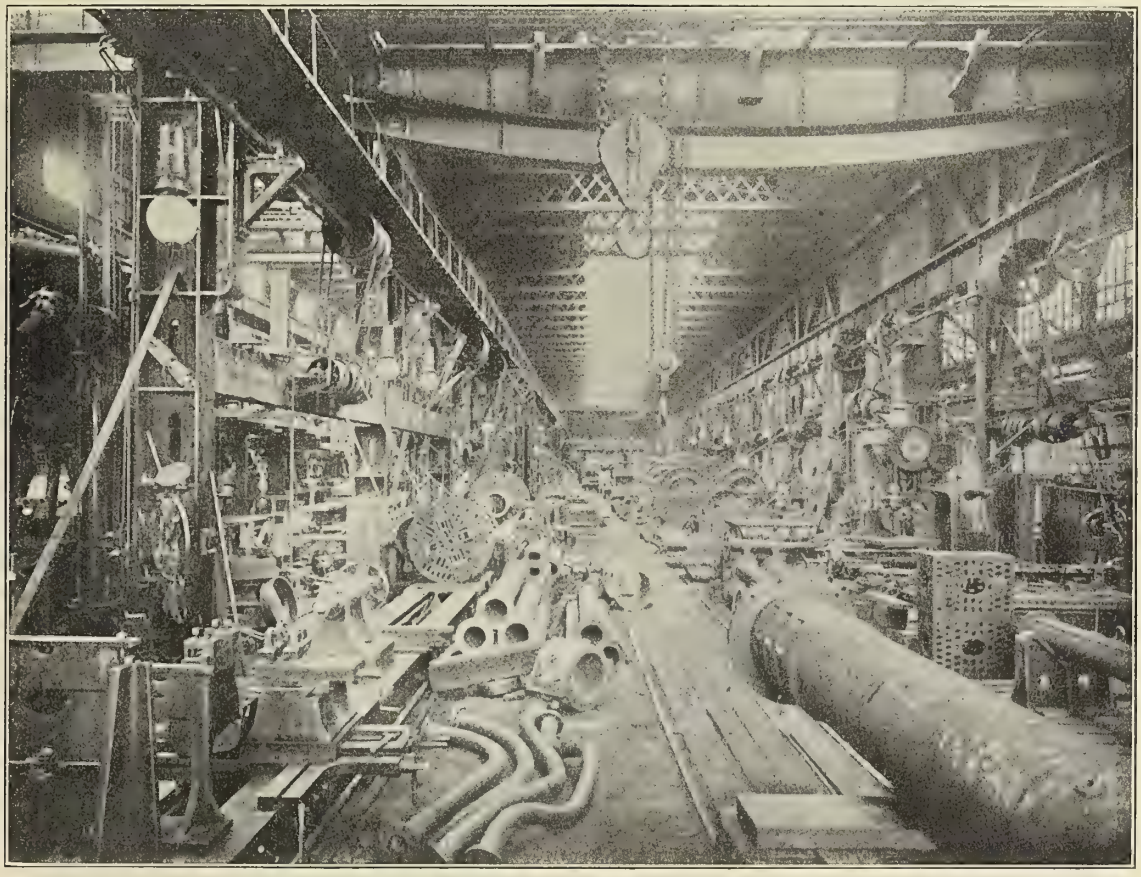
The berths are equipped with hydraulic four-ton jib cranes, at frequent intervals, for lifting weights on board during construction. In addition, there are several portable 10-ton cranes. In the large quadrangle immediately inside the entrance, in both east and west sections, where plates and angles are stored, are located 10-ton portable cranes for handling these materials. To facilitate conveyance of materials, the works include five miles of narrow gage railway and six miles of standard gage, the latter being in direct connection with both the Caledonia and the North British railways.

The mold loft, which is thoroughly well lighted, has a length of 250 feet and a width of 55 feet. The roof is of light steel construction, while the sides are entirely of glass.

The frame bending shop in the eastern yard is about 250 feet square. It includes three angle iron furnaces, 61 feet long, with a large floor area devoted to the process of bending them into shape. The usual equipment of forges and shears, together with hydraulic cutting and planing machines is alongside.

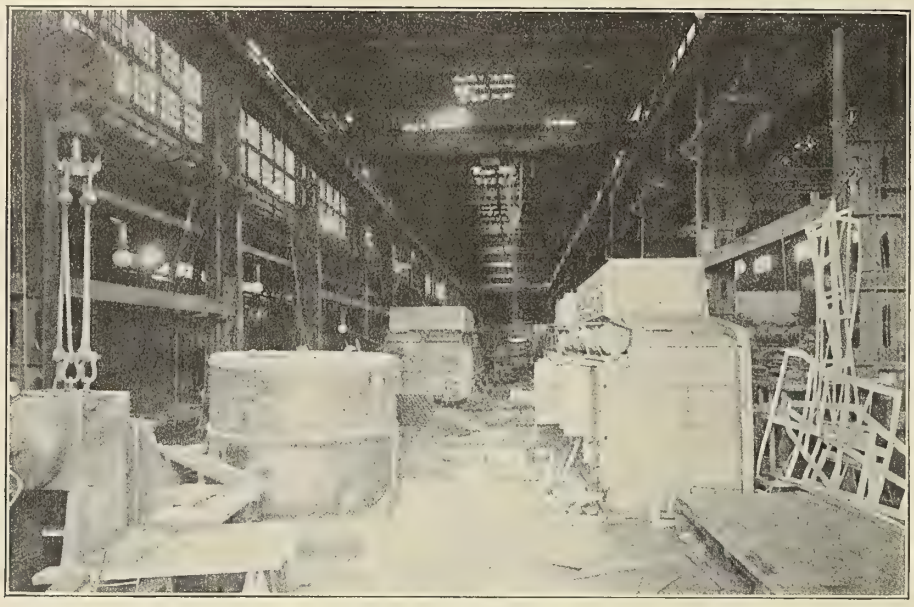
The iron workers' machine shed measures 350 by 150 feet, in three bays, with two lines of shafting for driving the machines. It contains heavy machine tools, including about thirty punching and shearing machines, ranging up to tools with a capacity for 1½-inch plates, while a gap of 42 inches enables plates 7 feet wide to be handled. There are two hydraulic manhole punches, capable of working holes up to 36 by 22 inches, while two other smaller machines are arranged for cutting elliptical and circular manholes.

The tools in the plater's shed are designed to work on material up to 35 feet long by 7 feet wide. The bending rolls deal with plates up to 1½ inches in thickness, the top roller, which is a solid steel forging, weighing 45 tons. In this same department are two other sets of rolls of somewhat less power. There are five planing machines, a mangle for straightening plates, two plate cutting machines for light work, and a full equipment of radial drills. In the west yard a similar equipment is found, the gradual expansion of the works having made it necessary to provide more extended facilities for handling it. Full advantage has been taken of experience in bringing the latest part of the equipment thoroughly up to date. The two yards, as a matter of fact, are practically in duplicate, so far as iron working is concerned. Other departments, however, are more or less concentrated.



THE LARGE MACHINE SHOP OF THE ENGINE WORKS DEPARTMENT AT CLYDEBANK.

The engine works is compactly arranged near the head of the fitting out basin. For several years the average output has exceeded 60,000 indicated horsepower per annum, the number of men engaged in this department alone being about 3,000. The main engine shop consists of a building 410 by 360 feet, divided into four main bays. The latter are utilized as delivery department, large machine shop, erecting department and small machine shops. The erecting bay is placed between the two machine shop



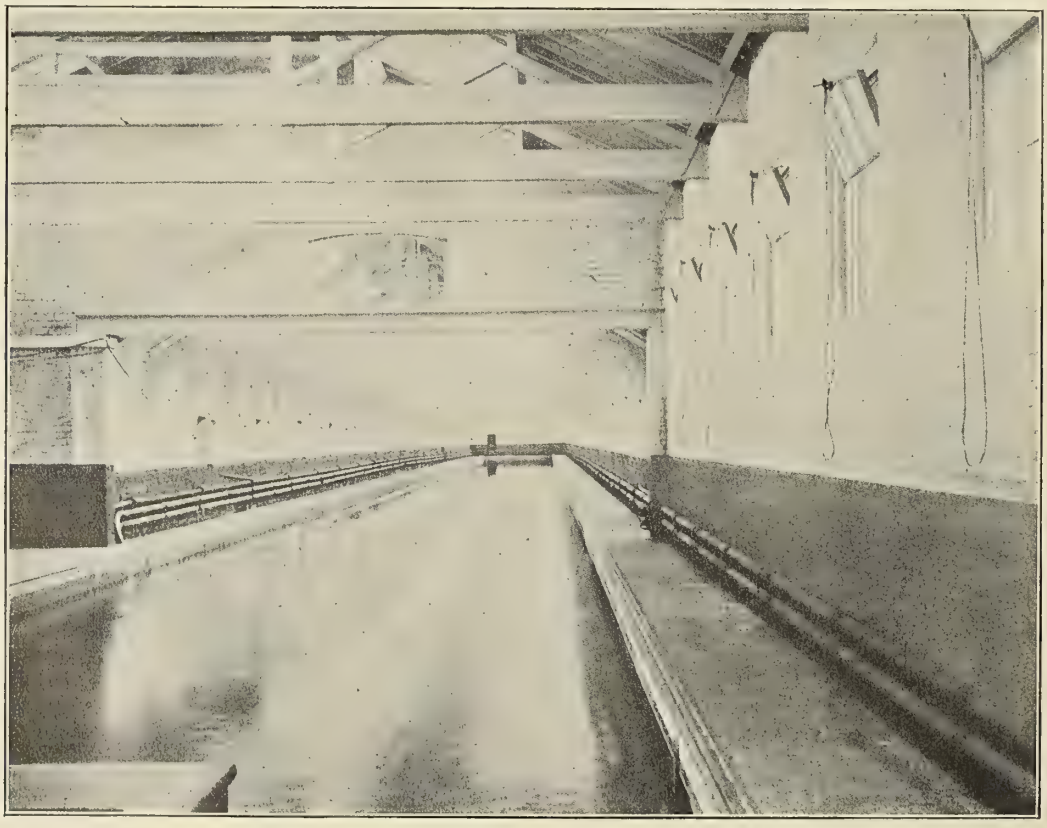
THE CENTER BAY OF THE BOILER SHOP OF THE CLYDEBANK YARD.

bays in order to minimize handling. The smith shop, connected with the engine works, has 70 fires, with 13 steam hammers and several air furnaces. Forgings of considerable size are here produced for engines and boilers of ships. The erecting shop contains two 40-ton overhead traveling cranes and a number of hydraulic jib cranes. The machine tools are unusually large and powerful, and are well served by the cranes.

The main boiler works are opposite the engine shops, the building, 410 by 140 feet, being divided into three bays. In the two largest bays cylindrical boilers are constructed, and several very powerful tools are located here for handling and working the large plates. There is a plate furnace measuring 20 by 10 feet, served by a powerful steam hammer. The third bay is used for the construction and erection of watertube boilers.

The brass foundry is situated to the west of the main engine shop, and measures 150 by 250 feet. The equipment includes air furnaces ranging in capacity from 5 to 16 tons; large drying stoves; cranes of all types, besides the usual outfit of foundry machinery. There is a 3-ton cupola for such iron casting as is necessary in the department. Brass castings up to 25 tons have been made.

There are three power houses, one for operating the tools in the shipyard, another for the engine works, and a third for the saw mill and forge departments. The shipyard plant is operated by six Babcock and Wilcox boilers, which provide steam for the shear leg engines alongside, as well as for running the electric generating sets. They also serve as destructors, being used for the disposal of sawdust and shavings, and rubbish from the



THE MODEL EXPERIMENTAL TANK IS AN EXTREMELY USEFUL ADJUNCT TO THE YARD.

ships under construction. The station includes three different types of steam engines and five different types of dynamos. The total engine power is above 900 horsepower.

The engine works generating station differs from that of the shipyard in that the dynamos are run by gas engines operating with producer gas. These engines were built by the Premier Gas Engine Company, and include four single cylinder engines, three of 150 and one of 250 indicated horsepower, while four tandem engines of the same type generate 500 horsepower each. The engines are direct coupled to dynamos of the multipolar type, constructed by Bruce, Peebles & Company, Limited. The speed of the single cylinder engines is 150 revolutions per minute with a maximum pressure of 315 pounds above the atmosphere, and a mean effective pressure of 110 pounds per square inch.

In 1903 an experimental tank was installed for testing the models of ships' hulls. The buildng is situated at the west boundary of the yard. The tank, which lies due north and south, has an extreme length of about 400 feet, a clear width of 20 feet and a depth of water of 8 feet at one end and 9 feet at the other. At the end of the tank are dry and wet docks, for trimming the models, which measure 20 feet in length. There is a passage of 4 feet in width on each side, the roof having a span of 28 feet, and being largely taken up by skylights. Near the docks is the necessary gear for making models, with automatic cutting machines and weighing machines. The carriage, from which the model is towed through the water, runs on rails fixed on each side of the concrete walls of the tank, and is driven by electricity. The dynamometric apparatus is designed so as to avoid all consequences of friction in the equipment.

This basin is an invaluable part of the plant, enabling the determination of the power necessary to be given any new ship for the development of the desired speed. A still more valuable use, however, is in the determination of the most suitable form of model to fulfil any given set of conditions, and to attain, with least expenditure of power, any required speed.

Notes on Vacuum in Connection with Marine Machinery.

BY LIEUTENANT H. C. DINGER, U. S. N.

Nothing has a greater effect on the economical performance of a marine engineering plant than the continual maintenance of the highest possible vacuum. Yet this matter is very often most sadly neglected by the personnel intrusted with the operation of the engine, and, sometimes, due to unfamiliarity with the underlying scientific principles of thermodynamic operations, the condensing apparatus is operated so that very many heat units, which it might be possible to save and put to useful work, are lost. The fact can not be too thoroughly realized, that an increase in vacuum is a great possible gain in power, which can be obtained with very little expenditure of energy.

It is fully as important to keep up a high vacuum as it is to maintain a high steam pressure; and it should always be remembered that every pound of vacuum obtained is a pound added to the mean effective pressure of the engine. This being the case, it will always pay to be continually searching for and remedying the causes which tend to decrease the vacuum.

With proper design and all of the condensing apparatus in proper order, a vacuum of 27 to 28 inches of mercury can be maintained. To show what a great loss an improper vacuum may cause, we will take a case and follow it out. Supposing that, due to leaks or to bad operation, a vacuum of only 24 inches is maintained (this is not uncommon). With a triple expansion engine using steam at 180 pounds, the mean effective pressure referred to low-pressure cylinder will be about 32 pounds at full power. The difference in vacuum between 28 and 24 inches is equal to 2 pounds, so that when only 24 inches of vacuum is carried, there is a loss of 2 pounds in the mean effective pressure, equivalent to 6.2 percent of the power developed. This, of course, means for equal power, an increase of 6.2 percent in the coal bill, as well as in the manual labor of the firemen.

Various matters that affect the vacuum in one way or another will now be considered.

Air Leaks.—All joints in the exhaust piping must be kept tight, and any leakage due to holes or fractures must be avoided. These joints are low-pressure joints, and are not very difficult to keep tight. The slightest air leak has a tremendous effect upon the vacuum, since the air, which can not be condensed, does at the same time displace the steam, and thus renders the *condensing* space it occupies uneffective for *condensing* purposes.

Efficiency of Air Pump.—This can be kept up by keeping plungers and pistons properly packed, all parts in alinement, the valves in good order, and clear of grease, and the springs above them properly but not too tightly set up.

Circulating Pump—This pump must furnish a sufficient amount of cooling water to the condenser to properly condense the steam. Whether or not this is being done can be determined from the temperature of the discharge water. In all cases the discharge water must be at a slightly lower temperature than that of the vapor corresponding to the vacuum it is desired to maintain. The temperature of the vapor of steam under various conditions of vacuum is given in the table:

Inches of Vacuum	Temperature in degrees Fahr.	Inches of Vacuum	Temperature in degrees Fahr.	Inches of Vacuum	Temperature in degrees Fahr.
0	212	11	189.81	22	151.97
1	210.29	12	187.30	23	146.55
2	208.54	13	184.66	24	140.42
3	206.73	14	181.88	25	133.32
4	204.86	15	178.96	26	124.89
5	202.94	16	175.87	27	114.34
6	200.95	17	172.59	28	100.05
7	198.89	18	169.07	29	76.80
8	196.75	19	165.31	29½	54.21
9	194.53	20	161.25		
10	192.23	21	156.83		

Hence, if a vacuum of 28 inches is aimed at, the discharge water must be below 100 degrees, and sufficient circulating water must be supplied to get this temperature of discharge. It need not be much below this; in fact, lowering the temperature much below this point will simply mean cooling the feed water. Therefore, with cool circulating water the circulating pump can be run quite slowly, and still be doing all that is required. It is simply wasting steam to run the circulating pump fast when the cooling effect is not needed.

Condenser.—The back pressure in the low-pressure cylinder at high power is often raised considerably by, (1) too small exhaust ports and pipes; (2) sharp and irregular turns in exhaust passages; (3) too much baffling in condenser, or tubes spaced too closely; (4) dirty tubes. In fact, all matters that tend to obstruct the free passage of the exhaust steam to the cooling surface, and every thing tending, in any way, to reduce the efficiency of the cooling surface, decreases the effective vacuum.

The exhaust passages should be of ample size, and the exhaust pipes should have as short and as direct a lead to the condenser as is possible. It is in these places that defects are often met with. Sometimes the exhaust passages are long, crooked, filled with sharp angles, turns and obstructions, which cause the loss in pressure necessary to force the volume of exhaust steam through. In other cases condensers are baffled too much, so that the flow of steam is much retarded.

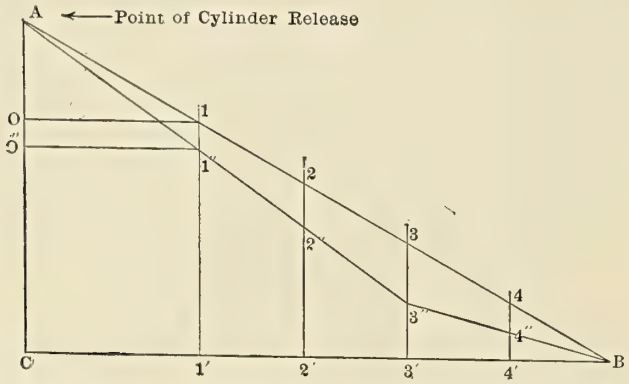
The cooling surface of the condenser should be arranged to offer the greatest surface to the steam as it enters the condenser. To this end all condensers should have proper avenues to allow the steam to get to the lower tubes. Proper baffles to

protect the tubes from the direct impact of the steam must, however, also be provided.

In the United States navy the circulating water is usually admitted to the lower part of the condenser first. In many vessels of the merchant service, the opposite practice, that is, supplying the circulating water first to the top, is the practice. Still another system, sometimes used in the British navy, is to have the division plate vertical. Here the water passes in on one side and back on the other.

The condenser should get the highest possible vacuum at a point as near as possible to the low-pressure cylinder. It appears that this desired result would be more readily obtained if the cooling water entered the condenser nearest to the entrance of the exhaust steam; because the exhaust steam should be condensed as soon as possible at a point nearest the cylinder, so that the back pressure in the cylinder may be the lowest that it is possible to obtain.

The difference in the effect of admitting the cooling water at the top and at the bottom of condenser may be graphically illustrated by the diagram.



Let *A C* represent the pressure above a perfect vacuum at air pump suction. The line *A B* will represent the gradual reduction of the steam pressure, as steam is condensed, from the cylinder to the bottom of the condenser.

1 1″ 1′ represents the back pressure in cylinder.

2 2″ 2′ represents the pressure in exhaust pipe.

3 3″ 3′ represents the pressure at top of condenser.

4 4″ 4′ represents the pressure at middle of condenser.

With the same vacuum at air pump, if the entrance of the cooling water is changed from the bottom to the top, there will be a tendency to lower the pressure at the point where the cooling water enters at the top of the condenser. Let us represent this effect so as to cause 3 to be brought down to 3″. Then the line *A* 1 2 3 changes to *A* 1″ 2″ 3″, and the back pressure in the cylinder is lowered the amount 1 1″, which represents so much mean effective pressure gained. Furthermore, it can be seen that any matter tending to reduce the resistance to the flow of the exhaust steam from the point of release in the cylinder to the point of condensation, will reduce the back pressure in the cylinder, and will consequently produce a direct gain in power.

To get the very most out of a proper condensing apparatus, it must be arranged so that all obstructions to the flow, or conditions that increase the effect of obstructions, or lengthen the distance between the cylinder and the point of condensation, should be avoided, if practical conditions will allow it to be done.

Ship Repairing in Venice. There has recently been installed in the harbor of Venice a floating dock capable of handling vessels up to a length of about 400 feet. Heretofore, whenever repairs were required on the bottom of a vessel, it has been necessary to make use of one of the dry-docks in the government arsenal, which involved heavy expenses and exasperating delays. The new dock should do away with much of the difficulty and annoyance heretofore prevalent in this connection.

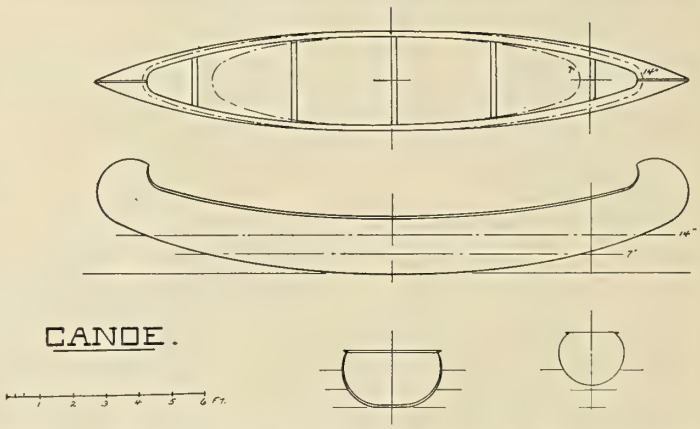
Eskimo and Indian Boats of Labrador.

BY STEPHEN P. M. TASKER.

There are three separate and distinct types of boats used on the Hudson Bay, Hudson Strait and Atlantic coasts of Labrador. It is here, and especially on the bay and strait, that we find the native and his boat as, with little change, he was hundreds of years ago. The only difference seems to be, in the case of the Indian, substituting birch bark, which, not only in this sparsely wooded region, but in the well timbered regions to the south, is scarce, by canvas, which he can procure at a few of the posts for furs. This material comes in width up to 102 inches, which is wide enough without a seam for their largest freight canoes.

In the case of the Eskimo, contact with a trader now and then results in some wire or nails where sinew had been used before; otherwise the model and method of construction have not been changed. Canvas, for their use, does not seem satisfactory, besides the difficulty in getting it, and the great distance from the post to their camp-grounds.

The Labrador canoe, as found from the lower edge of James Bay to about the fifty-eighth parallel of North latitude, where the Eskimo and Indian over-lap, is about eighteen feet long, three feet wide and two feet deep, and of a model very different from the craft made further south, with which we are all familiar. As the sketch shows, it is deep, high-sided, undecked, with large over-hangs and great sheer. Naturally this shape has, from its construction, with frames of one piece from gunwale to gunwale, a round section and blunt water-line, and is in smooth water a hard paddler, bad for rapids and river work, but almost perfect for the rough and open water as found on the eastern coast of Hudson Bay, with the prevailing northwest



winds. The Indian is perfectly at home in this canoe, and never, as far as I could find, will he risk himself in the Eskimo production, whereas the Eskimo does not object to using the canoe if there is occasion to do so. Some time ago it was necessary to take Indians from the shore to a sealer when quite a sea was running, and not one would risk himself in the large and able surf boat, but all stuck to their little Whale River canoes.

The Indian carries his entire outfit and family in the one canoe:—two single-blade paddles, with the woman 'way down in the bow, cramped up like a mummy, a blanket for a sail, and with one of the paddles acting as centerboard and rudder. While the majority of these canoes are fairly short, they are made up to thirty-six feet, with corresponding beam, and of birch bark, invariably requiring a man to continually bail. They do not stand the rough work of the well-made canvas covered canoes, but are lighter.

The Eskimo oomiak, in which he carries his several wives, their families, a pack of husky dogs and entire outfit, is a large skin-boat, about thirty feet long, six feet wide and three feet deep, with a flat floor and circular ends, propelled by women at the oars, and occasionally fitted with a skin sail and rudder. This boat is extremely slow and hard to manage, and its great

carrying capacity is its only advantage. In traveling, the head of the household goes in his kayak (ki-ak) where he is perfectly independent, free from hard labor, and always on the lookout for game and camp sites. He carries no baggage in the kayak, except in emergencies, when a passenger can be accommodated flat on the after deck; seals, as they are killed, are stowed inside, but a landing is necessary for this operation.

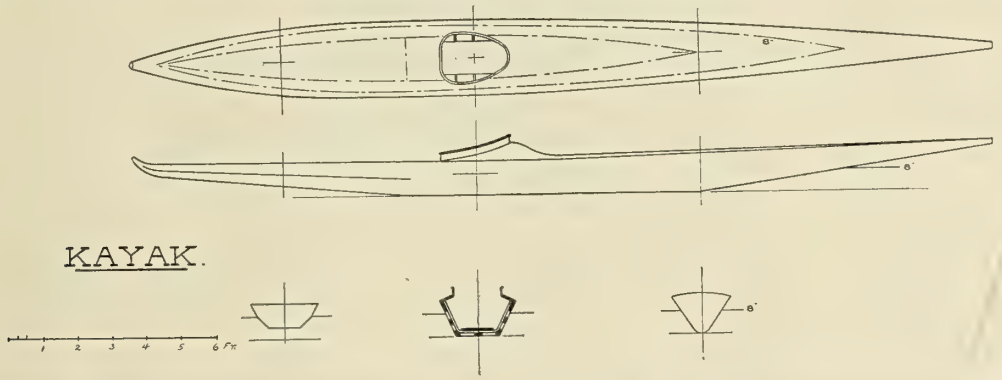
With his "dicky" (a seamless jacket and hood combined) tied around the coaming, this kayak is almost unsinkable; one of the Eskimo's favorite games is to ride over and capsize his opponent, and they are so expert at righting themselves that there is little if any danger. To us, paddling in one of these boats, while capable of showing great speed, is tiresome, as the paddle is heavy and the deck high. The Eskimo has not learned to make a feathering paddle, and on account of wind resistance and scarcity of suitable wood, keeps the blade down to two inches in width.

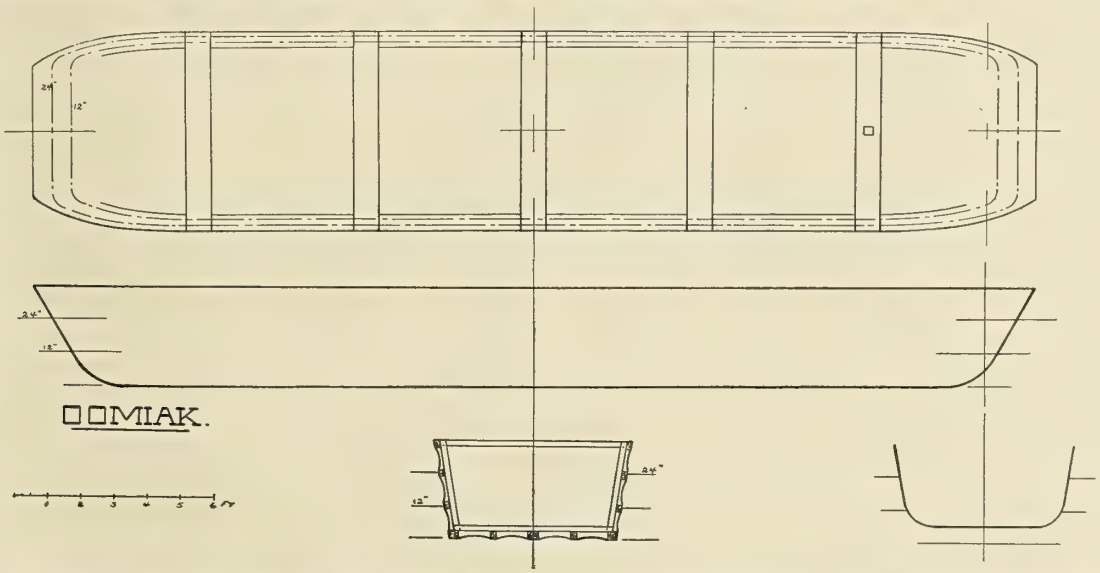
Having a length of twenty to thirty feet and a width of from fifteen to eighteen inches on the water, and their very smooth surface, accounts for the great speed; the high sides and tightness for the seaworthiness. The entire kayak is fastened with sinew, frames of juniper, and covering of very neatly sewed seal skin, of which are required eight or ten of the ordinary seal, but only three or four of the "square flipper" seal, which are not so plentiful. Tanning the skin makes a creamy white and very showy boat, as hard as board, and thin ice is the only thing they have to guard against. Few Eskimos go to the trouble of tanning, and the dark brown, foul-smelling cover is almost universal.

Instruments for hunting, and for navigating the boat are carried lashed on deck, together with an inflated seal-skin (entire animal) to which is attached by walrus thong the ivory lance on the harpoon. This prevents the dead seal from sinking, and incidentally acts as a life preserver in cases of emergency.

In examining and using a number of these kayaks, the writer found no difference in construction or model, whereas in the Indian canoe, no two seemed to paddle nor be shaped alike. The numerous skins are beautifully sewed together, and the kayak, taken as a whole, is a credit to any mechanic, let alone a race of childish people, badly handicapped for materials and tools.

The delicate gracefulness of this boat is in hard contrast to the clumsy and awkward oomiak, but taken together these crude boats of skin, bone and wood are indispensable to the living of the little people of the north.





CRANES FOR SHIPBUILDING BERTHS.*

BY CARLO PIAGGIO.

The question of labor-saving appliances in dealing with shipbuilding materials is at present attracting great attention. The description of a system of electric cranes which has proved highly successful after three years' practice will be found of some interest. Early in the year 1904 the Società Esercizio Bacini decided to provide their shipyard at Riva, near Genoa, with pneumatic tools, and with such modern appliances as tend to reduce time and expense in the hoisting and placing of materials on vessels in process of building.

Of the systems then in use none was found to answer the purpose perfectly, and all entailed such a large expense that the advantage of time and labor saved did not appear sufficiently compensating; it was only after an attentive study of the question that it was decided to solve the problem by a new method, leading to the installation under description, which has been found to satisfy the following principal practical requirements:

(1) Ability to take materials lying on the ground in any part of the yard near the berths, and to carry them rapidly to the exact position on the vessels being built.

(2) Moderate first cost and expense of up-keep.

(3) Greatly reduced incumbrance.

*Read before the Institution of Naval Architects, March 21, 1907.

(4) Possibility of carrying on work in different parts of the vessel at the same time and independently.

(5) Possibility of launching vessels with masts and funnels in place. This condition is important only for shipyards which, like those in Italy, launch vessels completely finished.

It should be recalled that the Riva installation was the first of its kind, and it must not, therefore, be considered as the very best one might expect to-day. However, its daily results in practice appear quite sufficient for a correct judgment of the system to be arrived at.

The plant consists of six electric tower cranes of 1.5 tons capacity each, working on three berths. In 1906 a new crane was added; the height of the jib of this crane is 90 feet. Each crane consists of a steel lattice-work tower of prismatic shape fixed on a concrete block. In the center line of the tower is placed the turning mast, which is supported by a spherical support fixed on the concrete block and kept vertical by rollers fitted on the upper part of the tower. The horizontal jib on which the load truck travels consists of channel irons made rigid by lattice-work, and sustained by steel stay bars at the top of the turning mast.

There are in each crane three 110-volt continuous current motors. One motor of 8.3 horsepower actuates the lifting winch, one of 2.1 horsepower moves the truck along the horizontal jib, and the third of 3.2 horsepower gives the turning movement to the crane. All the motors, winches, and controllers are in the operator's cabin, fitted under the jib, and are under his immediate control. As the three movements are independent, they can be made together, thus reducing waste of time in maneuvering. The electric current is conveyed to the motors from the bases of the cranes by bronze rings and copper brushes. The short arm of the horizontal jib carries the counterweight, which has been calculated in such a way as to counterbalance a weight of 750 kilos (half load) at the end of the jib.

The principal features of the cranes are:

Safe load	1.5 tons.
Height of horizontal jib, from	69 feet to 82 feet.
Lifting speed	50 feet per minute.
Traveling speed of the load truck	92 feet per minute.
Turning speed at the extremity of the jib	400 feet per minute.

The six cranes are placed in two rows, three on each side of the central berth, and as near as possible to the side berths; the distance depending upon the breadth of vessels which are to be laid on them. Crowding is thus greatly reduced, the central berth remains capable of taking a vessel of very large breadth, and it is not necessary to lay the berths too near. A railway well away from all interference on the external side of each lateral berth is sufficient for the three berths, as the working radius of the cranes exceeds the maximum breadth of vessels building. Practically, the cranes have, alongside the outer berths, a far greater range than that given by the jib's length, as a load can be hoisted lying far away from the ground covered by the jibs.

Three years' working experience has proved the excellence of this equipment, and so far the only expenses in upkeep are limited to the changing of steel wire ropes, an outlay of a few pounds. I have said above that the Riva installation is not quite complete; in fact, with vessels of more than 300 feet on berth, a portion of the vessels (aft and forward) is not covered by the cranes. As to the safe load on the traveling truck being limited to 1.5 tons for each crane, experience has proved it to be sufficient in all general cases, so that it does not seem necessary to increase it a great deal for the sake of a few heavier loads to be dealt with. It must be remembered that interest and sinking fund are the highest items of expense of such an installation, and I think it would be an economical mistake to design cranes capable of dealing with the greatest weights, that might have to be lifted only occasionally.

A new and complete crane equipment for three berths for ships of, say, 460 feet long might be installed as follows:

The three berths should be placed at a distance of 100 feet between center lines, and the center of each crane respectively 44 feet from the lateral berth's center line. The cranes of the type described above should be eight in number, each of 2½ tons lifting capacity, in two rows, four in each. The height of the horizontal jib from the ground should be about 100 feet for the four forward, 82 feet for the two aft, and 90 feet for the central ones. All the cranes should have a working radius of 82 feet, and three independent motors, one for lifting, one for moving the truck load, and one for turning the crane. The speed capacity should be as follows:

Lifting speed	80 feet per minute.
Horizontal speed	95 feet per minute.
Turning speed at the extremity of the jib	400 feet per minute.

The ground area practically covered by the cranes, as stated, is far greater than that limited by the jibs' length, as, by allowing the hoisting rope to assume an inclination of, say, 30 degrees with the vertical, weights up to 2 tons lying about 130 feet from the center of the crane can be safely handled. The yard area occupied by the cranes is very small. The towers can be utilized for the installation of water pipes, compressed air, and electric mains for use on the berths. The total cost of such an installation is about £10,000, foundations included.

In comparing these figures with those given at the last spring meeting by Mr. Murray, it must be observed that the latter referred to two berths for vessels of 400 feet length and 53 feet breadth, while in our case the sum of £10,000 is for three berths, and for vessels of 460 feet and corresponding breadth. Leaving aside the difference of the vessels' dimensions, and considering only the number of berths, the expense incurred upon two berths would be reduced to £6,600.

The comparison of expenses between the various systems in use would be as follows:

Type.	Cost, including foundations.	Annual expense taken at 16 per cent.	Labor saved over old mast or derrick system.	Gain.
	£	£	£	£
Cantilever type	11,500	1,840	1,720	120*
Cantilever with addition of two side cranes	14,800	2,368	2,580	212
Lattice pillars with skeleton roof carrying three traveling cranes over each berth	28,500	4,560	2,580	1,980*
Lattice pillars with glazed roof, saving lost time in bad weather	32,000	5,120	2,838	2,282*
Lattice pillars with connecting girders carrying one large traveling crane for each berth	26,250	4 200	2,660	1,540*
Tower crane as described, two cranes per berth, equal to four cranes on permanent ways	11 900	1,904	2,660	756
Tower cranes, Riva type	6,700	1,072	2,660	1,588

*Loss.

Japanese steamship lines in the tea trade, and making Formosa and Amoy the principal ports of shipment, have been making large inroads into the British shipping interests in that quarter of the globe. Three British steamship lines were formerly operated between Formosa and Amoy, but they have been largely driven out of service, and a great many of their ships are tied up in Hong Kong or Shanghai. One firm which formerly operated seven ships is now using only three. The Japanese competitors operate eleven ships up and down the coast, and their continued success is due in large measure to their being subsidized by the Japanese government. This enables them to maintain a service with freight rates so low that they cannot be met by the British companies.

THE CAUSES AND PREVENTION OF FIRE AT SEA.*

BY PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S.

During the first five years of the present century fire at sea resulted in the total loss of 141 vessels, having a total tonnage of 162,594 tons, while the total number of fires would approximate to twenty times this number. It is clear that the financial importance, entirely apart from the dread nature of the subject, demands all the attention we can give it. The conditions existing on board ship differ so widely from those on land that ideas gleaned from fires on shore are somewhat misleading if taken in more than their general application. In shore fires we are dealing largely with dangers to the structure and fittings of dwelling houses, and it is only when we come to warehouse fires that any great analogy can be found with fires at sea.

Since the advent of iron and steel ships, risk from the structure is but small, and it is danger from fittings and cargo that becomes the first consideration, and this entirely alters the ratio of danger existing among the various causes of fire.

CAUSE.

Taking the fire returns for 1904 in London, Liverpool, Manchester, Glasgow, Leeds, and Sheffield, we find that the chief ascertained causes of fire were: Matches, 1,695; overheating from defective flues and fireplaces, 853; gas, 464; oil lamps, 408; candles, 327. These amount to 80 percent of the total fires; while these causes probably did not play any important part in more than 5 percent of the fires taking place at sea.

In analyzing the statistics of the returns of losses by fire at sea, one finds, as might be expected, that the general cargo occupies the pride of place, while coal, fiber cargoes like cotton and jute, petroleum and other oils, grain and timber, figure in the order named; but such statistics are somewhat misleading, as the number of ships carrying general cargo enormously outnumber all others.

Statistics, however, do give us a clue as to the class of fires that are most dangerous when once started, and, if we tabulate the probable causes of fire and the total losses from these causes, we gain a valuable insight into what we may term the danger risk:

	Percentage of cause of fires.	Percentage of total loss.
General cargo	51	64
Coal	10	20
Oil	7	10
Cotton and jute	32	6
	100	100

These figures certainly seem to show that a fire on a ship freighted with coal or oil is the most dangerous when once started, while the general cargo comes next, and that fires in a cargo of fiber, although bulking largely in occurrence, are the least dangerous to the life of the ship.

There are three causes which overshadow all others in leading to disaster from fire, and these are:

(1) Spontaneous ignition taking place in a homogeneous cargo, or in one unit of a mixed cargo.

(2) The unwitting admixture in a general cargo of substances liable to raise the temperature to the ignition point by chemical action on each other.

(3) The carriage of substances liable to give off inflammable fumes or vapors, which, igniting some distance from the cargo itself, cause explosion and fire.

All fibrous structures when closely packed in bulk are liable, when slightly moist and subjected to pressure from the weight of material stored above, to undergo heating, and if a trace of oil or fatty matter be present, this heating becomes so excessive as to often lead to spontaneous ignition. Of the ordinary fibers, cotton, jute, flax, ramie, and hemp are more dangerous than animal fibers, like wool and silk, this being due to the fact that the vegetable fibers really consist of microscopic tubes, which contain the necessary amount of air to set up oxidation processes, all of which emit heat, while wool and silk being practically solid do not themselves contain air, although in packing it is impossible to avoid the presence of air in the spaces between the fibers, and under certain conditions this leads to heating. The extraordinary effect which the smallest trace of animal or vegetable oil has in exciting this action and increasing it to the point of ignition of the mass is thoroughly recognized, and is due to both oil and fiber.

It is well known that some oils have the property of drying more rapidly than others, and that if a powdered pigment be mixed with boiled linseed oil the paint so formed will harden and dry in a few hours, while if ordinary lamp oil be employed no drying action would take place. The drying of oils is due to the power which they possess of taking oxygen from the air and becoming converted into resins, the change from the liquid oil to the solid resin causing the hardening. This process, however, like all processes of oxidation, gives rise to heat, which, although it escapes our notice when taking place in the drying of paint spread over a considerable surface exposed to air, yet makes itself very manifest when the oil in a fine state of division is spread over the surface of such non-conducting materials as cotton or other fabrics of a similar character, and it needs only a few pounds of such materials to be allowed to collect in a heap for ignition to follow in a comparatively short space of time. Jute offers the same dangers as cotton when in bulk, and when oiled, spontaneous ignition sometimes occurs even more easily than with cotton; while the same danger is found when the jute is in a thoroughly dry condition, and exposed to moderate warmth from a steam pipe or flue, or even the rays of the sun. Even wool when compressed in bales becomes dangerous when slightly moistened by rain during making up, although spontaneous ignition does not often result.

Not only does danger from spontaneous ignition exist in the fibrous structures when in the raw condition, but fabrics made from them, if oiled or greased, are actively dangerous in even small quantity, a package of oiled silk umbrella cases having been known to ignite a general cargo. Oils and fats vary much in their power of heating when spread on the surface of vegetable fibers, linseed oil being the most dangerous, while mineral oils are not only themselves practically harmless, but when mixed with animal oils retard their action.

Another danger with such cargoes of fibrous material is that they are often very dusty, and the dust is so inflammable that when mixed with air a spark from the impact of the iron bands on the bale or the nails in a stevedore's boot striking on an angle iron is enough to cause ignition, and a flame will run through the dusty air as easily as through an explosive gaseous mixture. It must always be clearly borne in mind that, although the ignition point of a substance is an unalterable temperature, both for the mass and particles from that mass, yet it is far easier to heat the substance in a fine state of division to the required temperature than to raise the temperature of the large mass.

For instance, iron ignites at about 1,500° C. (2,732° F.), and gunpowder at a little over 250° C. (482° F.), yet if some alcohol in a dish be ignited, and finely divided iron dust be thrown into it, the iron burns brilliantly in the flame, while grains of gunpowder may be thrown through the flame without ignition, and will remain unacted upon in the alcohol until it is nearly all burnt away, when the flame, burning down to them and being in contact with them for some time, heats them to the necessary temperature, and so ignites them. In the same way a very small flame held in contact with a block of wood fails to ignite it, while a splint or shaving cut from the block is easily ignited by the same flame.

In a general cargo the chance of fire from the chemical actions brought about by the mixing of substances that have leaked from various packages during heavy weather is a very prolific

*Read before the Institution of Naval Architects, March 22, 1907.

cause of fire, and one which could be avoided only by a deep knowledge of the scientific side of the question, many apparently harmless substances causing fierce combustion when mixed. It would not be feasible to deal with all possible causes in a general paper, but I may point out one or two unexpected actions of this character, which have come under my own observation.

Permanganate of potash is a crystalline body, which, dissolved in water, gives a disinfectant owing its valuable cleansing and antiseptic properties to its power of giving up oxygen to oxidizable compounds. Glycerine, on the other hand, is the sweet, oily liquid so largely used for toilet preparations, and no one would for a moment look upon its shipment in a general cargo as a source of danger, but should a bottle of glycerine crack and the liquid flow on to a package of permanganate of potash, the result would be a combustion so fierce that the combustible portions of the cargo would become involved.

Again, rope and other material treated with tar and turpentine is often found in a general cargo, and I have investigated a case in which chlorine gas evolved from some barrels of bleaching powder in the same hold caused a serious fire, by its action on the turpentine in some rope waste. Nitric acid leaking on to turpentine, charcoal, or other carbonaceous material, causes fire, while the breaking of a carboy of sulphuric acid would lead to serious trouble in very many cases. It is impossible in a mixed cargo, the contents of which are rarely known to the stevedore, to avoid danger, and all that can be done is to avoid as far as possible packing bodies rich in oxygen in the same hold as easily oxidizable material.

The third cause of fire is the formation of combustible vapors from easily volatile bodies, these vapors either finding their way through a leaky bulkhead to some source of fire, igniting and burning back to the source from which they sprang, or else forming an explosive mixture with the air in the hold. This has been the cause of most cases of fire in oil ships, in which crude mineral oil or petroleum spirit was being carried. When the oil comes from the well it consists of a mixture of a large number of different hydrocarbons, some of them, like petrol (gasoline) or petroleum spirit, being excessively volatile, and giving off inflammable vapor well below the ordinary air temperature; while others, again, have to be heated to a certain temperature before any inflammable vapor is developed. The temperature at which such vapor comes off is termed its flash point, while the firing or ignition point of the oil is generally well above this. It is the flash point, however, which is the factor of danger, as, if it be too low, vapors capable of yielding explosive mixtures with air are given off, and are liable to cause very serious trouble.

One of the greatest dangers with the vapor of volatile hydrocarbons is that the great weight of the vapor as compared with air will cause it to creep along surfaces for very long distances, and then on reaching a light the flame flashes back along the vapor to the source from which it sprang. It may be accepted that the transport and storage of refined lamp oils and residuum are practically free from danger, the only point to be guarded against being the ignition of the liquids in volume during fires, while the real dangers to be guarded against are to be found in the transport and storage of crude oils containing highly volatile constituents, and with petroleum spirit.

Besides the causes of fire enumerated, there of course exist those inseparable from the careless use of lights, smoking, electrical dangers, and many others, which, however, sink into relative insignificance as compared with the three primary causes.

(To be concluded.)

For the generating plant of the new Cunard steamship *Mauretania,* four Parsons turbo-generators are to be installed, each capable of furnishing 4,000 amperes at 110 volts (440 kilowatts each). A large portion of the auxiliary machinery will be electric driven, in addition to which provision has been made for about 5,000 lamps of 16 candlepower each. Electricity will be used for operating watertight doors, searchlights and telephones.

An Italo-American Emigrant Steamer.

The Fairfield Shipbuilding & Engineering Company, Ltd., Glasgow, has launched the *Volturno,* a twin screw steamer, 340 feet long, 43 feet broad, and 31 feet 3 inches deep, for the Navigazione Italo-Americana (De Martino & Co.) of Naples, classed according to British Corporation rules, and intended for the company's trade between Italy and America.

Accommodation is provided on the main and upper decks for 1,500 emigrants, and 24 saloon passengers can be carried on the shelter deck. This vessel has been built throughout to the latest requirements of the Italian Emigration Committee, with special care to the sanitary and ventilation arrangements. The space occupied by emigrants is ventilated and heated on the thermotank system, so that the whole volume of air can be changed six times an hour, and a temperature of 65 degrees F. maintained with the atmosphere at 12 degrees F. Hospitals, both infectious and non-infectious, are arranged on the upper deck, and washhouses, with hot showers, are provided for the use of the emigrants.

A full equipment of life-saving apparatus is provided—ten lifeboats and the usual lifebelts and buoys. Steam fire extinguishing arrangements are provided, and in the event of fire in any hold or 'tween deck, the steam can be turned on immediately from the weather deck to any compartment desired. A complete installation of electric light is fitted; combined steam and hand steering gear is in a deckhouse aft, worked with controlling shafting from the flying bridge; a powerful windlass by Clarke, Chapman & Co., and four strong horizontal winches, are fitted on the shelter deck for working the cargo.

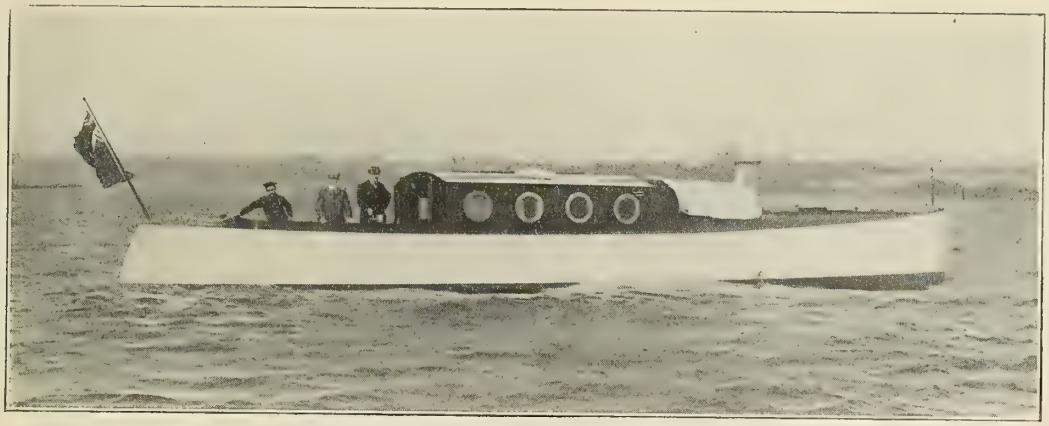
There are two independent sets of inverted triple expansion engines, each with three cylinders and cranks. The high-pressure cylinders have piston valves and the intermediate- and low-pressure cylinders are fitted with double-ported flat slide valves, all worked by the usual link motion. The cylinders are supported by cast iron columns, and the condenser, of cast iron, is incorporated with the framing of the engines. The air pumps are placed behind the condensers, and are worked by levers from the intermediate crossheads. The crank shafts are of the built-up type, and with the thrust, tunnel and propeller shafting are of forged steel.

Steam is supplied at a pressure of 180 pounds per square inch by two large single-ended boilers, fitted with Howden's forced draft. There is in the auxiliary machinery a large evaporator, and also a distilling condenser to provide fresh water. The circulating pumps are driven by independent engines, and are fitted with a suction from the bilge, to enable them to quickly discharge a large quantity of water from the vessel.

The English Cruising Launch Britannia III.

The launch is 55 feet in length with a beam of 7½ feet; and it is maintained that considering her speed and length she is unusually dry, having a generous proportion of freeboard, with her forward parts well flared. She was constructed at the Britannia works, Colchester, by the Britannia Engineering Co., Ltd., and it is stated that a speed of 13 knots can be obtained under ordinary conditions, with a considerably higher speed during still water and in good weather.

The vessel is provided with two six-cylinder motors, each having a capacity of 45 horsepower, driving twin screws. The six-cylinder engines were employed with the idea that they would give cooler running than four-cylinder units, while the division of power into two engines would render the liability to complete disablement well nigh impossible. It is said that there is less vibration from the two 45-horsepower engines than with a single unit of 90 horsepower capacity, as there is a better distribution

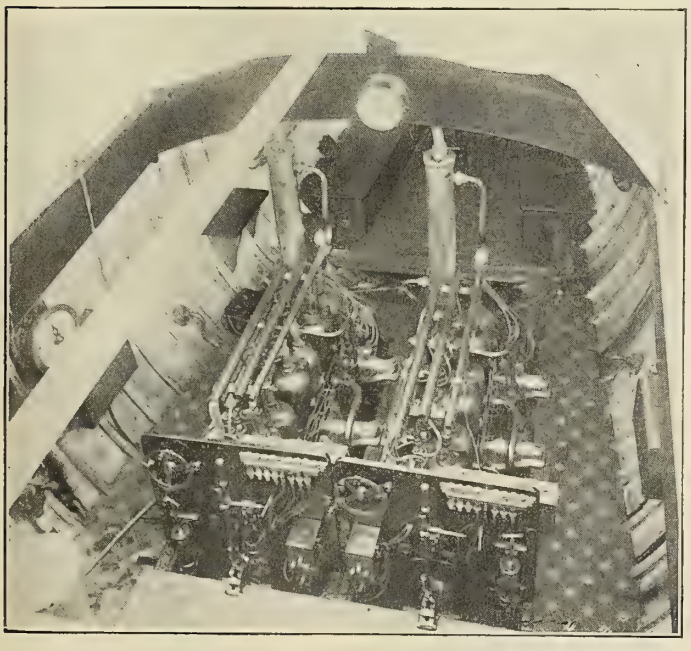


SIR THOMAS LIPTON'S MOTOR CRUISING LAUNCH BRITANNIA III.
(Photographs by Topical.)

of the vibratory impulses, and also smaller amplitude of these impulses. The engine room and forecastle are completely covered, ventilators being provided in the forward deck for supplying fresh air, and a canvas spray hood may be stretched from the cabin roof to the forward coaming, on hooks which run on brass rails on the side of the coaming, and when desired it may be folded back.

The cylinders of the two motors are cast in pairs, with the valves all on the port side, the carbureter being placed opposite, while two independent means of ignition are provided for each motor with separate sets of spark plugs. The engines may be operated with electric ignition from the batteries with their single coils and high tension distributors, or the motors may be ignited by the high tension magnetos provided with independent distributors. The storage batteries can be charged from the lighting dynamos when necessary, by the manipulation of the proper switch, there being two well designed and equipped control switchboards located above the fly wheel, as shown in one illustration. These control boards are equipped with not only the control levers and switches, but also the oil feeds and coils for each set. For the battery ignition sets the distributors are placed in a horizontal position level with the top of, and behind, the boards, while the magnetos are mounted on brackets at the side of the forward pair of cylinders of each motor.

For lubrication there is a battery of sight feeds as shown, the lubricating oil being pumped from large tanks on the walls of the engine room to small tanks at the back of the control boards. The fuel is carried in a pair of tanks in the forward cabin bulkhead, and is fed by gravity to the carbureters, while the main supply tanks, which hold 30 gallons each, are located aft under the cockpit benches. The gravity feed tanks are filled with gasoline (petrol) by a semi-rotary pump, a system of shunt piping being provided around the pump so that the fuel may be run back to the main tanks when the engines are not in operation. It will thus be noted that each engine is separately supplied with lubricating oil and gasoline, and has also separate water pumps and gages, making each entirely independent of the other.



THE ENGINES AND SWITCHBOARDS OF THE BRITANNIA III.

THE CABIN OF THE CRUISING LAUNCH BRITANNIA III.

There are separate mufflers in the funnel, through which the gases escape without disagreeable noise, the exhaust being carried from each engine to the muffler by a water-cooled pipe. Each propeller is driven through a universal joint with a reversing plate clutch. The boat is lighted throughout with electric incandescent lamps, a set of storage batteries being provided together with a small dynamo for charging, as well as for direct lighting service, being driven from each engine by belt transmission.

There is 6 feet 4 inches of headroom in the cabin, which is provided with a long sofa on each side, a small cellarette at the forward end, also a folding table in the center; while a sliding door in the forward bulkhead closes the passage to the engine room. Around the cockpit are arranged benches covered with pegamoid cushions. It is stated that for comfort, speed and dryness this launch has been most satisfactory to its owner, Sir Thomas Lipton. It is said to be a most clean running boat, the stern wave being very small, even when full speed is attained.

A LARGE OIL STEAMER.

The Gulf Refining Company, the largest shipper of Texas crude oil and its products, whose refinery at Port Arthur, Texas, is the largest independent oil refinery in the country, has just contracted with the New York Shipbuilding Company for the construction of the largest tank steamer ever built in the United States. The Gulf Pipe Line Company is now constructing 500 miles of eight-inch pipe line, which will connect the Indian Territory oil fields with the Port Arthur refinery; and the increased business which will follow the completion of this line necessitates adding this steamer to the present considerable fleet, already the second largest in the business. This will be the ninth oil vessel that has been built by the New York Shipbuilding Company; more than has been turned out by any other American shipyard.

The principal dimensions of the new steamer, which was designed by Matteson & Drake of Philadelphia, and is being built under their supervision, are as follows:

Length over all	441 feet.
Length between perpendiculars	425 feet.
Beam, molded	55 feet.
Depth, molded to spar deck	30 feet.
Mean draft	23 feet 6 inches.
Gross tonnage, about	5,800

The cargo oil capacity is 2,520,000 gallons, and besides this the deadweight on the above draft includes fuel oil, feed water, drinking water, stores and water in cofferdams. The vessel will be built under special survey of the Bureau Veritas, and will receive their highest classification mark. In point of size, this steamer ranks among the largest in the oil carrying trade of the world. She is about 1,800 tons larger than the next largest American-built oil steamer.

The vessel has the propelling machinery aft, and is of the spar deck type with open forecastle, bridge, and a raised quarter deck aft. Two decks run fore and aft except as mentioned above, in way of machinery space. The cargo oil is carried in sixteen tanks, formed by nine transverse bulkheads, and a center line longitudinal bulkhead. Aft of these is the pump room, which occupies the center of the ship on an oil tight flat twelve feet above the keel. On either side and below this room are the two fuel oil tanks.

An expansion trunk, ten feet wide and extending between the main and spar decks, is fitted each side of the central line bulkhead and for the full length of the cargo and fuel oil spaces. The sides are extended down to the flat in the fuel oil space and inclose the pump room.

The main deck spaces abreast the expansion trunk are divided into four compartments. The forward compartment on each side is for package freight, and the other six are summer oil tanks—to be used when a cargo of light oil is carried, or in summer when a less freeboard is allowed. Each of the main oil holds and wing compartments—twenty-four in all—is fitted with a hatch 6 feet 6 inches by 6 feet, having a steel oil-tight cover. Over the pump room is a steel skylight 20 feet by 6 feet having a companion way on one side.

Aft of the fuel oil tanks and pump room and separated by a cofferdam, which extends the full width and depth of the ship, is the machinery space. Coal bunkers are provided abreast the boiler room, and are filled through a hatch 20 feet by 4 feet in the raised quarter or poop deck, and a hatch and saddle back 20 feet by 8 feet 8 inches in the main deck. In the engine room, a gallery deck has been built, on which is located much of the auxiliary machinery.

A double bottom is fitted under the boiler room for carrying feedwater, and under the forward part of the engine room for water ballast. Between the oil holds and the fore peak tank package freight is carried in the hold and 'tween decks, fitted as usual with battens and ceiling. Access is made by means of hatches 19 feet 6 inches by 16 feet in each deck. The peak tanks extend to the main deck; over the forward peak is a storeroom, in the after end of which is the steel chain locker.

The bridge erection, which is 21 feet 8 inches long, is inclosed by steel bulkheads at each end. A large storeroom is located in the center, extending the full length. On each side are staterooms for the chief officer, second and third officers, three quartermasters, and carpenter and boatswain. There is also a spare stateroom and an officers' toilet room. On the bridge deck is a steel house 15 by 26 feet, containing the captain's quarters, which consists of stateroom, office and toilet; and wireless telegraph operator's room. Above this house is the navigator's bridge and a chart and wheel house. Quarters for the three assistant engineers, steward, cook, and boy, pumpman and machinist, three oilers, ten firemen, and ten sailors are provided under the raised quarter deck.

Around the engine casing on the raised quarter deck is a steel house 54 by 34 feet, containing the chief engineer's room, spare room, officers' and engineers' mess room, sailors' mess room, firemen's mess room, cold store room, galley, and pantry. Continuing forward from the house, and of the same height, is the boiler hatch inclosure. Inclosed stairways lead from this down to the sailors' and firemen's quarters, thus keeping these entirely separate from the engineers' quarters. The forward end of this sunken poop forms part of the coal bunkers. Extending between the bridge and raised quarter deck is a flying bridge, which permits safe communication between these two parts in all kinds of weather. The lamp room, paint and oil room, mates' store room, and carpenter's shop are built under the forecastle. Protection is also provided here for the windlass engine.

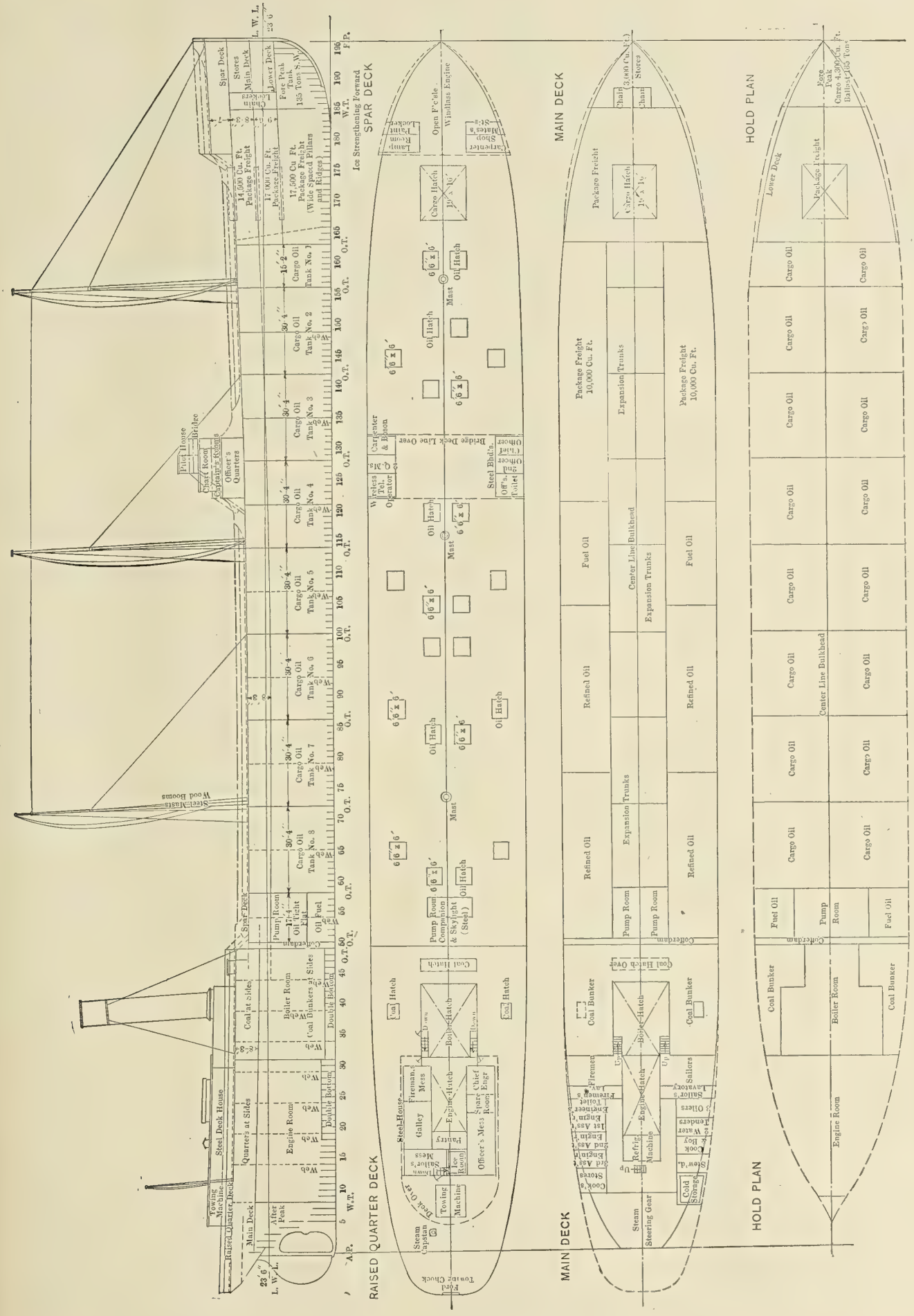
Three steel masts, each provided with two wooden cargo booms, are stepped on the spar deck, and are properly rigged for the usual steadying sails and for handling general cargo.

The scantlings and general construction of the steel hull are as required by the rules of the Bureau Veritas. The forward part of the vessel is specially strengthened to enable the ship to proceed safely through the thick ice that so frequently blocks the northern rivers and harbors in winter. Simplicity of construction and as few parts as possible have been the aim of the designers. The result of their labor is a structure that the system of work at the New York Shipbuilding Company can easily adapt itself to, large portions can be quickly and economically riveted together in the shop, and the whole rapidly assembled and completed on the ways.

Light and well ventilated quarters are provided for the officers and crew. This is a matter that cannot be overlooked in designing an oil steamer, or in fact any merchant ship. The efficiency of any vessel is governed so largely by the crew that it is decidedly necessary to provide good living spaces in order to attract the class of men who will take an interest in their work, and keep the machine and structure intrusted to their care in the best conditions for the work required. Ample toilet facilities are provided, including shower baths for the crew and tubs for the officers. Each stateroom has pipe berths with woven wire springs, a wash basin, lockers, drawers built under the berth, wardrobe and settee. The quarters for the firemen and sailors are provided with the same kind of berths and with metal lockers.

The finish is to be quartered white oak in the captain's quarters, two spare rooms, in each stateroom for wireless telegraph operator, first officer, second officer, and chief engineer, chart and wheel house, and officers' mess room. The finish of all the other rooms is to be white pine. As there are no wood decks, the tops of all rooms are ceiled with white pine, thus securing insulation against the extremes of temperature which would readily be transmitted by a bare steel deck. No quarters are adjacent to the boiler casing, and the crew spaces which extend to the engine casing have sufficient ventilation through the companion ways and side lights.

The floors in the living quarters in the poop are of cement and



INBOARD PROFILE AND DECK PLANS OF BULK OIL CARRYING STEAMER UNDER CONSTRUCTION BY THE NEW YORK SHIPBUILDING COMPANY FOR THE GULF REFINING COMPANY.

asphalt two inches thick, and covered with ¼-inch linoleum. Floors in the staterooms throughout the ship are white pine, secured to battens. Vitrified brick tiling is to be fitted on galley floor; hard faced white tiling will be used in all mess rooms and officers' toilet rooms. Side lights are all of brass; those through the hull sides are 12 inches in diameter in the clear, and are fitted with deadlight; those in the steel houses are 16 inches in diameter, but without deadlights. Deck lights are fitted in poop deck over all rooms below. All lights and outside doors are provided with brass wire screens, and as a further aid to ventilation all lights are provided with air scoops.

As a large proportion of the stores for the round trip are taken on at Philadelphia or New York, the refrigerating plant is necessarily large. There are three cold storage rooms—two adjacent on the main deck, and one in the poop deck house, entered from the pantry. Each of these is insulated by mineral wool, inclosed air spaces, and the usual wooden wall. A two-ton Allen dense air ice machine is installed on the gallery deck in the engine room; and besides being connected with the insulated chambers, is connected with ice pans of sufficient capacity to make 200 pounds of ice a day.

The miscellaneous fittings of the steamer are very complete, and embrace everything that can facilitate safe and efficient handling of the ship or cargo. Besides the Bureau Veritas requirement for manila and wire hawsers, there is furnished 520 fathoms of 2¼-inch diameter galvanized steel wire towing hawser. Ventilation for the oil cargo spaces is secured through 5-inch ventilator pipes in each hatch cover. Ordinary cowl ventilators of sufficient size and number are fitted for the package freight spaces and summer oil tanks. Watertight hinged steel covers may replace the portable cowls in stormy weather. Access to all parts of the ship is by means of metal ladders, those in the oil holds being made of ordinary angle bar stringers and bar rungs.

The deck outfit, which conforms to the requirements of the United States Steamboat Inspection Laws, includes the necessary number of fire buckets, extinguishers, axes, life preservers, and life buoys. There are three 20-foot metallic life boats, and a 20-foot wooden launch propelled by a six-horsepower gasoline engine. Hand deck pumps in number and size as required are provided. Two very important means of communication that are installed are the DeForest Wireless Telegraph outfit, and the submarine signal system, as manufactured by the Submarine Signal Company of Boston. The value of these two as means of saving life and property has become so well recognized that their adoption on board ship will soon cease to be a matter of comment, but will be deemed a matter of necessity.

Two drinking water tanks, of 3,750 gallons capacity each, are built in the forward wing compartments. On the after house is a distributing tank of 500 gallons capacity, which is directly connected with the galley sink and water heater in galley. The pump for filling the gravity tank is of the single piston type, 4 by 3 by 6 inches. The shower baths, tubs, and water closets are supplied with salt water from pressure tanks located on the bridge deck and fidley casing. This system is filled by a sanitary pump 5 by 4¾ by 6 inches.

The fire system consists of a three-inch main with connections about seventy-five feet apart for 2½-inch hose. At each plug is located a rack, with fifty feet of hose. Water from the sea is supplied by the following pumps: forward bilge pump, donkey pump, 12 by 6½ by 12 inches, and the auxiliary feed pump. The donkey pump has suction from all compartments in the after end of the ship, as well as the sea, and thus handles all water ballast. An independent bilge and ballast system is provided forward, which is connected with the forward pump.

A steering station is located on the aft house, as well as in the pilot house. From each of these places a telemotor connects with the steering engines located in the after end of the poop. There are two vertical engines 9 by 9 inches, mounted on a common bed plate, and arranged so that either may be readily thrown into gear. The rudder stock extends above the poop deck, and is provided with a spare tiller to be used in case both steam engines are disabled.

The deck machinery includes four mooring engines with double cylinders, 8 by 8 inches, and fitted with drums for handling 1⅛-inch wire rope; one deck winch with double cylinders 8 by 8 inches, provided with hoisting drum and two gypsies; a capstan on the poop deck, driven by an 8 by 8-inch double cylinder engine on the main deck; and a windlass for 2 3/16-inch chain. The windlass engine, located on the spar deck, is of the double reversible, vertical type, with cylinder 12 by 12 inches; this engine drives, through vertical worm shafts and bevel gearing, the windlass and drums of sufficient size and strength for handling 1¼-inch wire rope mooring lines. One gypsy lead is connected with each drum. A towing machine of extra heavy construction is located on the poop deck aft of the house, and protected by a continuation of the house top aft. The two cylinders are 18 by 20 inches, and are provided with reversing valve and automatic gear, capable of paying out eight fathoms of the hawser while opening the valve to its full extent. The drum of the machine is capable of stowing 3,200 feet of 2¼-inch wire hawser. An efficient foundation is provided between the poop and the main deck.

Perhaps the most important part of the engineering equipment of this type of steamer is the cargo oil system, which in this vessel is of the latest type, including every means available for the quick and safe handling of the cargo. The four pumps are of the Snow Steam Pump Company's duplex type, two being 16 by 14 by 12 inches, and two 8 by 6 by 12 inches. There is a 12-inch main suction line on each side of the center line bulkhead, with a 10-inch suction in the after end of each tank, and a 6-inch suction in the forward end. Gate valves are placed close to each suction. At each bulkhead the pipe line is provided with a cast iron expansion toe and a division valve. All valves are operated from the spar deck through stems fitted with universal joints and guided in brass or lignum vitae bushings. The piping is so connected up in the pump room that either main pump can pump from or discharge into any tank, or outboard. One auxiliary pump is connected with No. 8 tank on each side with a 5-inch suction main, and the other auxiliary pump is connected with No. 7 tank in a like manner. The forward ends of the main suction lines are connected above deck with a discharge opening and valves for loading, and the discharge from the oil pumps is led to a manifold on deck, with connections for either discharging or loading. For ventilating and drying the oil compartments, a 10 by 12¼ by 12 inch air compressor is provided in the pump room, and connected with the main cargo pipes. The oil pumps are also provided with a suction from the sea, and discharge into main condenser. Fire extinguishers are fitted to all oil tanks and fuel tanks, and are controlled by valves in the fidley hatch.

Electric lighting is used throughout the ship. Two 10-kilowatt General Electric generators are located on the gallery deck in the engine room, and are direct driven by Curtis turbines. All wiring except in the living quarters is run in iron conduits. An 18-inch search light projector is located on top of the pilot house. The entire system is installed with the utmost care, and all the fixtures are of the latest type.

The propelling machinery is of sufficient power to drive the vessel at a speed of eleven and one half knots when loaded to a mean draft of 23 feet 6 inches. The main engine is of the vertical inverted triple expansion type, having cylinders 28, 46 and 76 inches in diameter and a 54-inch stroke, developing the required power at 75 revolutions per minute. Bed plates and back housings are of cast iron, while the six front housings are of turned steel. All the valves are of the piston type, one for the high-pressure cylinder and two for each of the others, and are operated by Stephenson links. The Lovekin

assistant cylinder, type "A," is fitted to all valves, and by its use a considerable reduction is allowed in the size of the reciprocating part of this gear. The main engine is automatically controlled by an Aspinall governor. Receiver pipes and main exhaust pipes are of copper with steel flanges. The customary by-passes for admitting live steam to the intermediate and low-pressure receivers are provided; the valves being operated from the working platform. A single cylinder steam reversing gear of the "all around" type, and a hand reversing gear, are fitted—either being thrown out of gear when the other is used. Relief valves are provided for each receiver and the top and bottom of each cylinder. Copper drain pipes, operated from the working platform, lead from the cylinders and valve chest to the bilge and hot well. Complete oiling and water cooling arrangements are installed.

Mounted on a suitable structural foundation is the main condenser, which is of the cylindrical steel plate type, with cast iron bonnets, and tinned brass tubes. A vacuum of 27 inches can be maintained with circulating water at 86° Fahrenheit. A centrifugal pump with 14-inch suction, and driven by either one of two single engines 8 by 8 inches, will circulate sea water through the condenser. A twin vertical single air pump, having steam cylinders 11 by 18 inches and air cylinders 22 inches, is provided. The other principal auxiliaries are a Weir long stroke feed pump; auxiliary feed pump; a Wheeler auxiliary condenser, with combined air and circulating pump; evaporator of thirty tons' capacity in twenty-four hours; feed water heater; and "Mandigo" feed and filter tank.

Main steam pipes are of lap welded, wrought iron pipe, riveted to cast steel flanges. Auxiliary steam lines and lines to all deck machinery are of copper with composition flanges. Stop valves are fitted at boilers and expansion joints, traps and Foster reducing valves, where necessary. All exhaust piping is of copper with composition flanges. Leads from auxiliary and deck machinery pass to the auxiliary condenser, and to the escape pipe on the stack.

All the shafting is of the best open hearth forged steel, the tail shaft being 16¾ inches in diameter, the thrust and crank shafts 15½ inches. The crank shaft is in three interchangeable parts. A cast iron stern tube with lignum vitæ bearings is provided. The propeller is of the built-up type, having a cast iron hub and four Parsons manganese bronze blades.

Steam is generated by three single-ended Scotch boilers designed for a working pressure of 185 pounds per square inch. The shell of each boiler is made in one strake, having an inside diameter of 16 feet 6 inches. The length between heads is 10 feet 6 inches—the front head being internally flanged. Each boiler has four 41-inch inside diameter Morison corrugated furnaces, flanged to independent combustion chambers. The total heating surface is 9,900 square feet and the total grate surface 235 square feet. The ratio is 42.1 to 1. All usual boiler fittings are provided.

A forced draft system of the hot air type is installed. In the engine room on the gallery deck are two 72-inch fans driven by compound engines 5 and 10 by 6 inches, which deliver air through ducts to the furnace front. These ducts pass along the upper front of the boiler, and are provided with vertical pipes, through which the hot gases from the furnace pass on their way to the stack. An air pressure corresponding to a column of water 1½ inches high is maintained in the ash pit under normal conditions of working.

Oil fuel is to be used. The Lassoe-Lovekin system, which gave such excellent results on the steamers *Nevadan* and *Nebraskan,* is to be installed here. At each furnace there is one oil burner, which is supplied from the oil fuel settling tanks. Heated air from the forced draft system is delivered to the oil burners under low pressure by two rotary blowers, and thus vaporizes the fuel. For starting the oil fuel system a ten-horsepower coal burning boiler is installed.

Double uptakes and stack are fitted. Boilers, engines and all steam pipes are properly lagged with 85-percent magnesia covering, secured by sheet iron or other efficient method.

The list of spare parts for the machinery not only includes those required by the Bureau Veritas for a long voyage; but also a section of crank shaft, tail shaft, complete propeller, and in fact everything sufficient to make a complete disablement of the machinery almost impossible. Cast and incut iron ladders and gratings are fitted, so that all parts of the machinery are rendered easily accessible. Ample ventilation for the machinery spaces is secured through two 36-inch ventilators to the fireroom and four 24-inch and one 15-inch ventilators to the engine room. Two 15-inch ventilators serve the pump room. The machine shop is provided with a 6-foot turret lathe, a radial drill, benches and vises. The machine tools are driven by electric motors.

Method of Closing Large Sea Valve.

A small branch valve on the outboard delivery sea connection on a battleship became clogged up and it was necessary to plug the sea chest to enable the valve to be examined and cleared. The method adopted was as follows:

A molasses barrel was found that was a little larger at the bilge than the diameter of the opening, which was 17 inches. The end of the barrel was about an inch smaller in diameter than

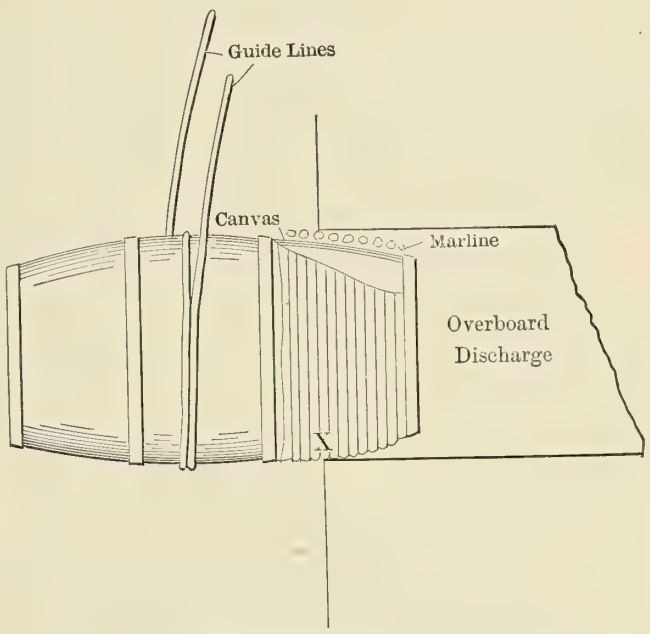


DIAGRAM SHOWING STOPPAGE OF DISCHARGE OPENING.

the opening. The end of the barrel was wrapped with old canvas, and then served with tarred marline, so that the outer circumference of the part X was the same as the diameter of the opening. The barrel was then fitted with two guiding lines, and filled with water so that it could just float, then the filling holes were plugged.

The diving apparatus was prepared and a diver sent down to place the barrel in the opening. It was difficult for him to get the barrel to stick in the opening, as he would get it entered but it would float out again. But after a good suction was created in the sea chest by opening the overboard discharge valve and letting the water drain into the bilge, the barrel was finally sucked in tightly. It leaked considerably around the upper edge, but after the diver inserted a wisp of oakum in this place the leakage stopped almost entirely. The deranged valve was then taken apart, and it was found that the valve disk and seat had become loose. After the valve was replaced, a slight pressure was put on the overboard discharge by a pump, and the barrel plug pushed out. H. C. D.

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The Jamestown Exposition Naval Review.

It was peculiarly fitting that the naval review in connection with the Jamestown Exposition should have been held where it was. Not only are those waters historical from the point of view of modern warfare, but they are especially so from the point of view of naval warfare and the development of the present types of warships. It will be recalled that on March 8, 1862, there occurred in Hampton Roads a naval action which sounded the knell of the wooden and unarmored fighting ship as the main defense of a nation. On that date the confederate armor clad *Manassas,* perhaps more generally known as the *Merrimac,* from the fact that she had been transposed from the old frigate *Merrimac,* steamed slowly out into the roads from the vicinity of Norfolk, and fought an action covering a comparatively few minutes, in which she sank one frigate and destroyed another by fire, these being the *Congress* and the *Cumberland.* No effort on the part of the valiant crews of these two vessels to inflict serious damage on their adversary had any result worthy of mention, and it was only the coming on of darkness which prevented the entire destruction of the national fleet of wooden walls anchored in the neighborhood.

During the night there appeared in the harbor, after an arduous journey from New York, the famous "cheesebox on a raft," which has written the name of Ericsson indelibly upon the pages of naval history. This vessel was the *Monitor,* the first of a long list of ships of this type, and the first vessel to carry heavy guns mounted in a revolving turret. Crude and awkward though this turret and its carrier were, they formed nevertheless the prototype of the modern war vessel, reaching its highest point of development in the leviathans built and building all over the world, of which perhaps the most prominent type is the *Dreadnought.* The action of March 9, 1862, between the *Monitor* and the *Merrimac,* was most far-reaching in its results upon the science of warship design and construction.

Armored vessels had been used before this, and in the Crimean war, which had occurred seven years previously, the French had a number of floating batteries armored with iron, and engaged in conflict with the land forts at Sebastopol. In both the English navy and the French navy armor had been placed upon steam frigates of the then prevailing type, as might be instanced in the case of the *Gloire* of France and the *Warrior* of England, both of which names have recently been given to armored cruisers of their respective countries. The *Merrimac,* however, formed a distinct departure from the frigate type, having no sail power whatever, and being, in fact, nothing but an armored hull surmounted by a redoubt or fort with sloping sides, and armored for want of better material, with railroad rails laid in two courses, one being horizontal and the other diagonally vertical. She was propelled by steam, and was fitted with a powerful ram.

It was the *Monitor,* however, which furnished the inspiration leading to modern developments along the line of military marine construction. This vessel consisted of an armored hull, as in the *Merrimac,* armored with iron plates, 4½ inches thick, and with an armored deck. The only projections above this deck when in fighting trim were the central turret, carrying two 11-inch muzzle-loading smooth bore guns, the smoke stack aft, and the pilot house, forward. From this type has gradually been evolved the modern battleship, with its numerous turrets, carrying sometimes two guns and sometimes one, and following the example of both the *Monitor* and the *Merrimac* in dispensing absolutely with sail power.

As the power of engines has increased—as the size of ship has increased—changes have come over the structure and the outline. The vessel has been made seagoing rather than fitted for purely harbor defense; the freeboard has been made high, in order to meet heavy seas and severe stress of weather; added size has carried with it demands for added fighting power, and the original single turret, having given way to two, has since developed to such an extent that in some of the latest vessels as many as eight turrets are carried. With each successive addition to the number of turrets, the arc of the horizon which each turret could command has necessarily become more or less constricted, and instead of the 360 degrees of the *Monitor,* we have now about 270 degrees for the main turrets forward and aft, and not above 180 degrees in general for the smaller turrets situated on the sides of the vessel.

Among the vessels participating in the review was the monitor *Canonicus,* which was built a few months later

than the original *Monitor,* and as such is a fair representative of the first turret-carrying vessel of any navy. Among the other vessels in the line of review were the American battleships *Indiana* and *Massachusetts,* which, with the famous *Oregon,* formed a trio built from the same designs, and which were the first battleships designed or constructed, of what might be called the modern type. That is to say, they were the first in which the four large guns mounted in turrets were supplemented by intermediate guns in turrets, as well as by the smaller artillery. This design gave a new impetus to the design of warships generally, and was really accountable for the development of design represented by the latest of the ships, not only among those present at the review, but of all large warships, either afloat or in process of construction.

The Causes and Prevention of Fire at Sea.

One of the most important of the papers read before the spring meeting of the Institution of Naval Architects was that one by Professor Lewes, of which the heading to this comment formed the title. The subject was divided up into three parts, covering respectively the causes of fire at sea; the prevention of such catastrophes; and means of fighting a fire, once started. It is pointed out that the three great causes which overshadow in importance all others are spontaneous ignition; the raising of a temperature to ignition point by chemical action between two or more substances unwittingly placed close together; and the presence of inflammable fumes or vapors, igniting possibly at some distance from the cargo from which they are given off.

Taking these three main causes as a starting point, the prevention has been briefly summarized under three headings, of which the first covers structural safeguards, consisting of subdividing the hold and other portions of the vessel as much as possible without interfering with other features in her operation, and of fitting as much fireproof wood as the circumstances of the case warrant. The second safeguard consists in protecting all steam pipes which might otherwise tend to raise the temperature of a portion of the cargo, and of protecting all the electric wiring in such a manner that no short circuit, with consequent spark, need be feared. The third subdivision under this heading is called administrative safeguards, and deals with the proper methods of stowing the cargo; with inspection at regular intervals, by patrols; and with the fitting of better fire fighting equipment than is usually found on shipboard.

When it comes to the question of fighting a fire already under way, the subject is not capable of so clear and logical a subdivision. Circumstances enter largely into the case, and while some fires might be fought with either water or steam, it would be folly to attempt to fight others by the same method. A fire fighting substance should have two properties. It should both lower the temperature of the burning mass below the point necessary for the continuance of the combustion, and it should deprive the combustion of the oxygen required for its support. Water fulfils perfectly the first of these conditions, but not the second. Steam fulfils the second, but not the first. There are certain gases, however, which have both properties in very marked degree. Carbon dioxide is one of these, and this has been recommended in the paper as perhaps the best existing means of fighting a stubborn fire, which is at all applicable to general use. The gas is inert, hence there need be no fear of any explosion; and it is harmless to the various substances and products which might go to make up the cargo.

Torpedo Craft.

Several pages of this number are devoted to descriptions of various torpedo boats, destroyers and submarines belonging to the different powers. In this connection it is interesting to note the extent to which this type of vessel has been built by the leading naval powers of the world.

Omitting submarine vessels, there were in service or under construction at the end of 1906 no less than 1,877 vessels of this character, ranging from the smallest size up to a displacement of 800 tons, and included among the navies of 25 nations. The advantage in numbers lay with the French, a total of 438 being included on their lists, as against 261 for Great Britain and 202 for Russia. The tonnage figures, however, tell a different story, for here Great Britain, with 70,701 tons, is far ahead of the French 51,295; and the Russian 32,232. The reason for the British predominance in displacement is the presence in their fleet of an unusually large number of the largest size. If we take simply the boats which exceed 200 tons displacement, we find that the British navy has 160, as compared with 64 for France, 61 for Germany and 59 for Russia. The displacement of the 160 British vessels is almost exactly equal to that of those of the other three powers combined.

If we omit from consideration, as being of comparatively small service, all vessels having a displacement of under 50 tons, and all having a trial speed of less than 22 knots, we find that France still has the lead in number, though not in displacement. The French navy includes 294 vessels under this heading as compared with 192 for Great Britain and 146 for Italy. In displacement, Great Britain has 66,488 tons as compared with 42,865 for France; 28,970 for Germany; and 27,020 for Russia. If we take from these latter figures merely those vessels which have made on trial at least 28 knots, we find that Great Britain has 78, against 58 for France and 56 for Japan. In displacement, Great Britain has 29,916 tons, as compared with 17,283 for France and 18,496 for Japan.

Of vessels upwards of 50 tons and 22 knots, the average size in the English navy is 346 tons, with an average speed of 28 knots. This is the largest average size, but the speed is exceeded by the Japanese vessels, which average 240 tons and 28.4 knots. The American vessels under this class, 46 in number, average 262 tons and 27.7 knots.

ENGINEERING SPECIALTIES.

Electric Wharf Cranes for Panama.

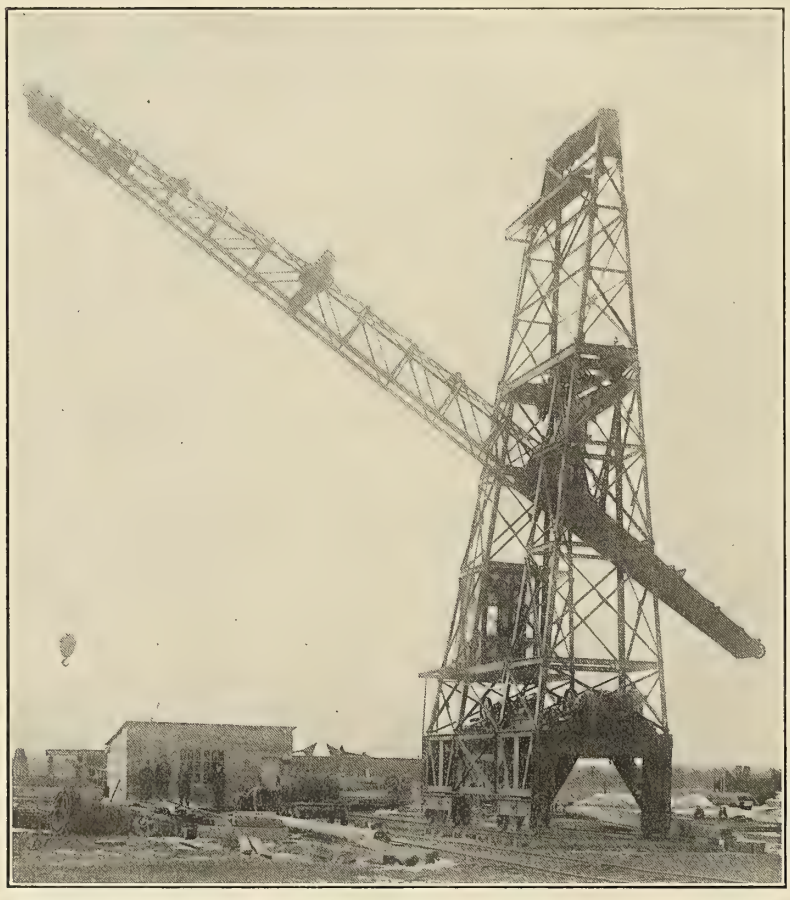
We present photographs of one of a lot of eight cranes under construction by the Shaw Electric Crane Co., Muskegon, Mich., for the Panama Railroad Co. They are for use in handling miscellaneous freight at the Laboca wharf, which is the Pacific terminus of the railroad. The cranes were designed to meet the peculiar conditions existing at the wharf, among which may be mentioned a tidal variation of about 20 feet.

The boom, which is 80 feet in length, is shown in its working position, standing at an angle a little over 30 degrees from horizontal. It is required that the outer end should stand at sufficient height to carry loads over the decks of the largest vessels at high tide, while the other end must be low enough to project inside of the warehouse door. The boom may be raised to the other position shown, carrying the outer end clear of all parts of vessels, and withdrawing the inner end from warehouse. With it in this position, vessels may be docked and the cranes placed opposite the various hatchways in proper position for loading or discharging cargoes.

The crane is mounted on six wheels, four under the front and two under the rear. Anticipating the possibility of uneven settling of the wooden wharf, the wheels are carried in equalizers, so arranged as to compensate for any probable irregularities of track, without straining the structure. The machinery for the various movements is placed in the base of the tower, adding to the stability of the crane, and giving easy access for inspection. For convenience in shipping and erecting, each set of machinery is mounted upon a separate frame, which is easily handled and put in place.

The crane has a regular working capacity of four tons, and a reach of 40 feet from the center line between rails to the extreme outer position of load. The total height of hoist is 70 feet, and the speed hoisting with full load is 150 feet per minute. The load can also be racked out and up at a speed of 150 feet per minute. The other two movements, travel and boom hoist, are relatively slow, being required only in setting the crane in position for service.

The hoist is operated by a 65-horsepower motor, the rack motion by a 40-horsepower and the travel and boom hoist by 24 and 8-horsepower motors respectively. Automatic switches



The main frame or tower is of steel construction, and stands 62 feet above the track. There is a clear opening through it 10 feet wide, in which the boom is suspended, and through which the loads are carried. The base is so constructed that the crane can travel over freight piled to a height of 6 feet between the tracks, and so that goods may be trucked directly from under the crane to the warehouse. The space between the front of warehouse and edge of wharf was sufficient for a track of only 11 feet gage. This, together with the necessary height and reach, made the question of stability a serious one. Although the weight of frame and machinery has been so disposed that the crane will be stable with a load 25 percent above normal capacity in the extreme position, clamps have been provided which are always in engagement with the rear rail, to prevent the crane from tipping if a load should become fouled on a hatchway or other part of the vessel.

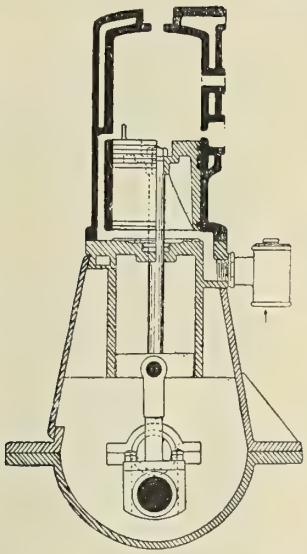
are provided, to prevent overtravel in hoisting and racking out, also an overload switch for the hoist machinery. All movements are under the control of one operator, whose cab is so located as to give him the best view of his work. The crane weighs nearly 50 tons, and with the boom in the raised position it stands 90 feet above the wharf.

The Reliable Motor Boat Engine.

One of the main features claimed for this engine, which is built by the Riverside Works Company of Weybridge, Surrey, is complete reliability. We are informed that it runs thoroughly well at a low number of revolutions, and can be depended upon implicitly for a good many hours of consecutive work without a stop. The designers have embodied in the engine so far as possible the principles obtaining in the marine steam engine, with

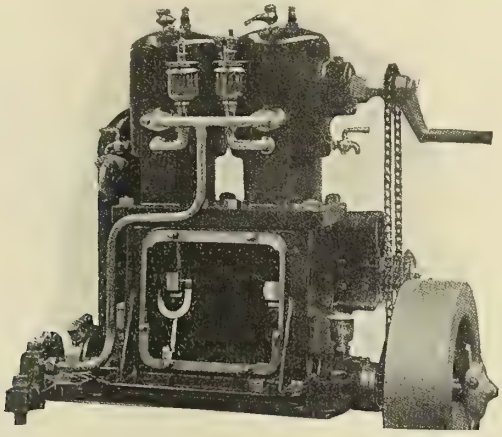
all parts accessible and adjustable, and with the fewest number possible.

The motor is of the two-cycle type, and may be used with either petrol (gasoline) or paraffin (kerosene). The two cuts which we show give respectively an outside view of one of



the two cylinder engines, and a transverse section through one of the cylinders. The former shows the starting device, common in British-built engines, the handle for cranking being in a convenient position instead of about the shaft, as is common in American practice.

This motor is said to differ from other two-cycle engines in that the crank case is not used as a storage or partial compression chamber for the explosive mixture. For this reason it is

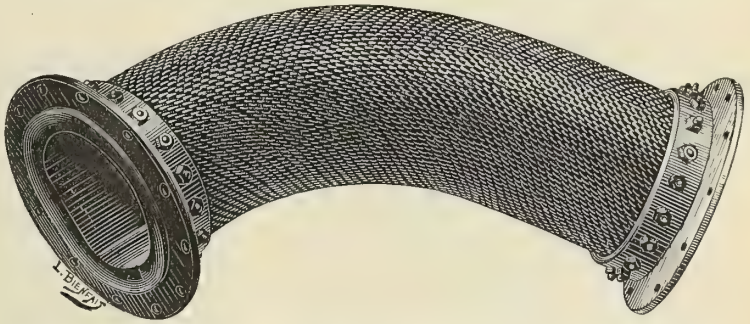


not necessarily made gas tight, and in the four-cylinder engine is of the open type, a sheet metal guard being placed around the lower part of the cylinder supports to prevent splashing of lubricating oil. The engines contain no valves, cams, or gear wheels, except the gears for the starting device; and all the working parts, except the pistons, are visible. The fuel does not come in contact with the lubricating oil or other foreign matter. The engine is run usually at about 500 revolutions per minute, but may be run at any figure between 250 and 1,000.

A Flexible Dredging Sleeve.

There has long been felt the need in dredging operations of a perfectly flexible sleeve for connecting the sections of the discharge mains, which would give better service and prove more economical than the rubber sleeves so widely used at present. In the Nyflexmet dredging sleeve is found an article which has met every requirement in some of the largest dredging operations conducted in Europe, and which is just now being introduced into America by the New York Flexible Metallic Hose & Tubing Co., 161-165 Lafayette street.

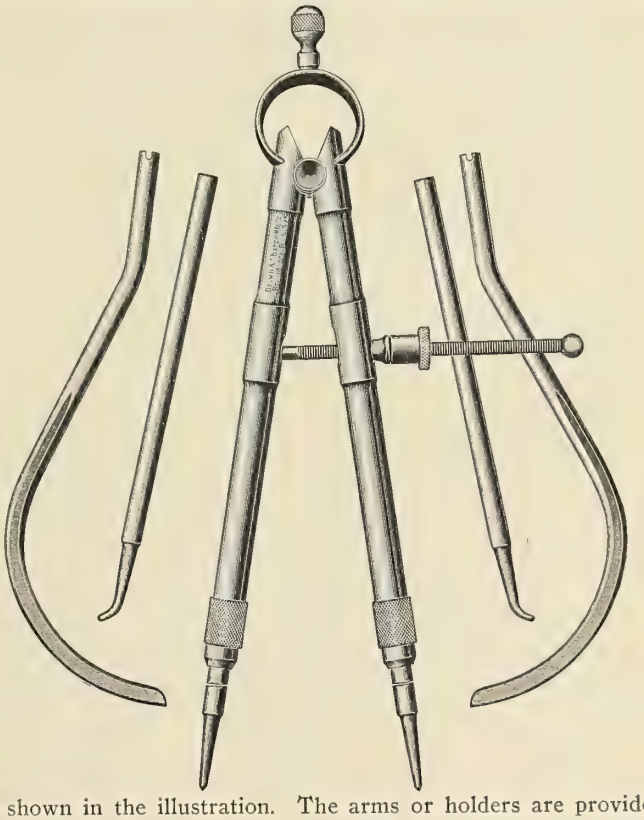
This sleeve is perfectly flexible, of watertight and waterproof leather, reinforced by an outer metal armor made of a strong articulated network woven from interlacing spirals of flattened steel wire, the whole forming a perfectly flexible covering similar to the ancient coats of chain mail. This sleeve is made to



connect any sizes of pipe, from eight to thirty inches diameter, and as constructed will stand the highest working pressures ordinarily occurring. It offers a resistance to deformation or piercing by external pressures or crushing weights, such as are often caused by blows, or the impact of falling stones and rubble. The woven armor in no way detracts from the flexibility of the watertight lining, but gives it strength to resist internal pressures, while protecting it perfectly from external injury. Each end of the sleeve is provided with a cast iron flange secured to the flexible hose through bolts and nuts made watertight by leather washers.

A Combination Caliper and Divider.

The Brown & Sharpe Manufacturing Company, Providence, R. I., has just placed upon the market a new combination tool which will be of interest to all metal workers. It combines in one outfit steel pointed dividers, inside calipers and outside calipers,

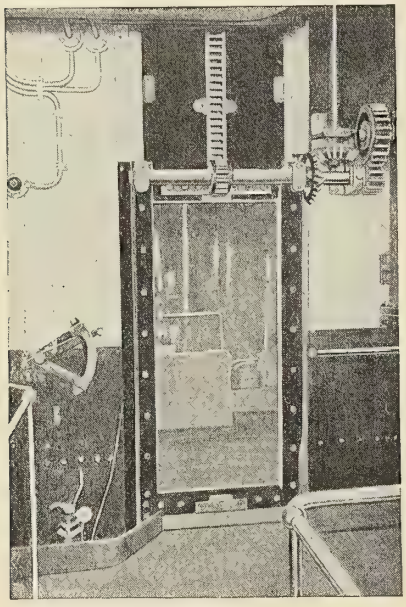


as shown in the illustration. The arms or holders are provided with split chucks to receive the auxiliary legs, which are held firmly in place by a simple turn of the knurled nut that closes the chuck concentrically. A pencil may be substituted, if desired, for one of the legs. The tool is of steel carefully finished,

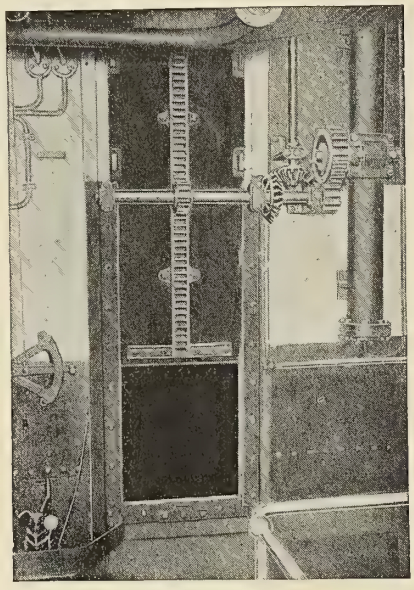
and with all sharp corners practically eliminated. Used as a divider, it will describe a circle with a diameter of 21½ inches. It is sold both as a divider alone and as a complete set.

Watertight Bulkhead Doors.

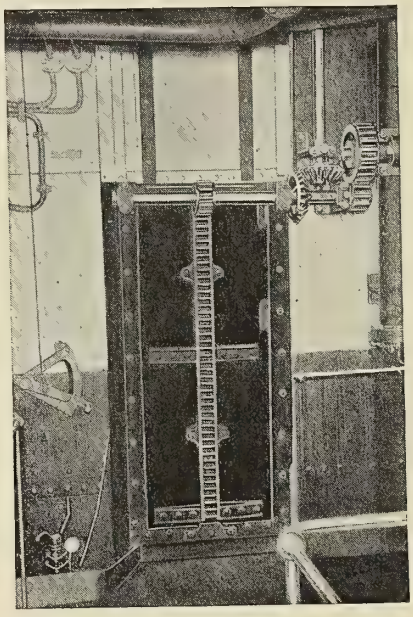
The Stone-Lloyd hydraulic gear, fitted for the closing of watertight doors in bulkheads on shipboard, has been developed by J. Stone & Company, Ltd., Deptford, London, S. E., and has been fitted to a large number of the most important vessels afloat. The doors are operated on both the horizontal slide and the vertical slide system.



DOOR OPEN.



DOOR CLOSING.



DOOR CLOSED.

The outfit, as placed upon the Hamburg-American steamer *Deutschland,* includes a pressure main running the entire length of the ship, and in communication with four capacious steam hydraulic accumulators of sufficient capacity when fully charged to supply pressure at from 500 to 700 pounds per square inch, and to close twenty-four doors, or to open and close eight doors, even should the pumps be stopped. The accumulators and pressure main are charged by a powerful duplex long-stroke slow-speed pump, capable of supplying pressure to close all the doors within ten or fifteen seconds, without drawing upon the accumulators. This pump draws from a 500-gallon tank which, together with the pump and accumulators, is above the water-line, thus insuring that the hydraulic installation be not stopped, even should the water enter the compartment where the pump is situated.

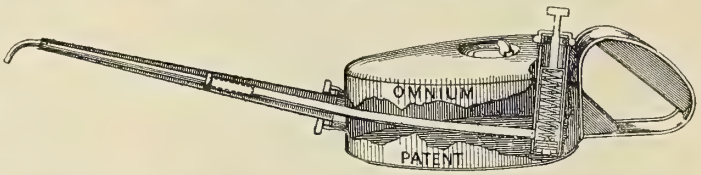
A branch from the pressure main rises to the bridge, and pressure can there be turned by means of a distribution box into either of two small pilot mains, running the length of the ship, one being arranged for operating the controlling valve to close each door, while the other opens the doors. Each door has a hydraulic differential cylinder of sufficient area to close the door under a force of 1½ or 2 tons; while the area of the "open" cylinder is such that a still greater force is available to open the doors. The valve may be operated by hand from a handle fitted on both sides of the bulkhead, and the door will remain in the position corresponding to the last movement of this handle. If, however, the pressure to open or to close all doors has been put on from the bridge the door will act automatically.

The exhaust main, which runs over the full length, empties into a 200-gallon tank in the engine room, from which a small auxiliary pump is also available for pumping at high pressure into the hydraulic pressure main.

The joints in the whole of the mains and cylinders are especially designed to withstand high pressures. The pressure fluid consists of three parts of water to one part of glycerine. This obviates danger of freezing, with resultant bursting of pipes, and also acts as a lubricant to the bearing surfaces, and as a preservative to the packings used in the joints. The temperture of the mains, which, in many cases, pass across the top of boilers and in close proximity to steam pipes, is kept down by constant circulation.

The Omnium Ejector Oil Can.

This invention is placed upon the market by R. Spence & Son, Trafalgar House, Richmond, Yorkshire, and has but three working parts, the plunger, disk and elevator. The oil is ejected by means of compressed air with sufficient force to reach a distance of 8 feet. It can also be ejected by gravity as in the ordinary can. When the plunger button is pressed open fully a positive feed is accomplished, making it possible to reach with this oiler holes inaccessible to others. No packing is used, and the working parts, being so few in number can, it is said, be removed and replaced in twenty seconds. The durability is said to be a special feature, and they are made in all ordinary shapes and sizes, and also to special shapes, as required.



TECHNICAL PUBLICATION.

How to Take Out Patents in England and Abroad. By E. and A. E. Edwards, Fellows of the Chartered Institute of Patent Agents. Size, 4¾ by 7¼ inches. Pages, 108. London: Edwards & Company, Chancery Lane Station Chambers. Price, 2s.

This little treatise aims at filling the gap between purely technical works on patent law and popular treatises which give very little information. It attempts to do so in such a manner that the inventor who intends to patent his invention may gain information of sufficient real value to save him time, trouble and expense, and to guide him in the proper steps to be taken. The work is divided into eight chapters, and is followed by an appendix and index. The first six chapters are devoted to descriptions of patents; how they may be obtained, what may be patented; what constitutes novelty; details of the specification; and

advice as to how to deal profitably with the patent. The seventh chapter covers the subject of foreign and colonial patents, under which heading the United States is given considerable attention. The last chapter gives a few figures on numbers of patents issued in various countries, and the cost of obtaining them. The appendix gives a list of acts of Parliament, covering patents.

Obituary.

Charles Haynes Haswell died May 12, lacking just ten days of 98 years of age. He was probably the oldest active engineer in the world, having been the first chief engineer in the United States navy, and also the first engineer-in-chief, serving from 1836 to 1851. He was known as the "father of the steam yacht," from the fact of his having, in 1832, launched the first vessel of this description. He was the author of several technical and other works, among which his "Engineers' Handbook" is the best known. His last few years were spent as superintending engineer of the Dock Department and of the Department of Charities of the city of New York, in which city he was born, May 22, 1809.

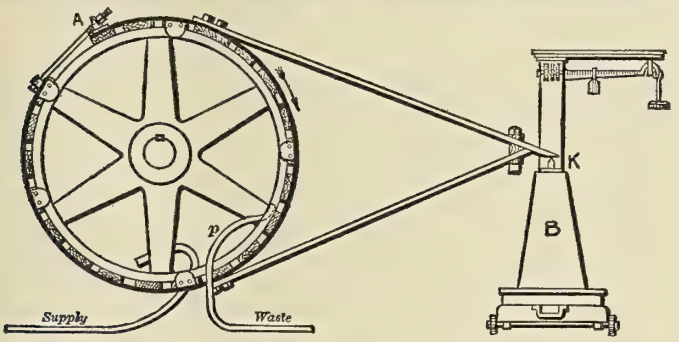
QUERIES AND ANSWERS.

All reasonable questions concerning marine engineering received from and signed by subscribers will be answered by the Editor in this column. All communications must bear the name and address of the writer.

Q. 369.—How can a test be made to determine the brake horsepower of a gasoline engine? J. M.

A.—We would suggest that you rig up a brake arm somewhat after the manner of the sketch, and place it upon the fly wheel of the engine. This can be arranged to be tightened to any desired extent by the screw at *A*, and, when used in conjunction with an ordinary platform scale, will readily give the amount of torque exerted by the engine. This torque, as measured in foot pounds, multiplied by the number of revolutions per minute, and divided by 33,000, will give the brake horsepower of the engine.

To take an example: suppose that the radius of the brake from center of flywheel to knife edge is 3 feet. This would make a circumference of 18.85 feet. If, when the engine is running at



full power, the downward pressure of the brake is 20 pounds, then the engine at each revolution is doing work represented by moving through a distance of 18.85 feet against a resistance of 20 pounds. This amounts to 377 foot pounds of work. If the engine runs at 500 revolutions per minute, then the work per minute will be represented by 188,500 foot pounds. Dividing this by 33,000, which is the number of foot pounds per minute in one horsepower, we have as a result 5.71 horsepower.

Care should be taken to have the knife edge *K* on a level with the center of the pulley or brake wheel. In making readings it will, of course, be obvious that the weight of the block, *B*, and of the brake when it is in position and resting loosely on the pulley, must always be subtracted from the figure as read from the scale, in order to get the *net* effect due to the operation of the engine. The brake should be kept cool by a stream of cold water let through the pipe *p*.

Q. 377.—What horsepower would be necessary to propel a motor boat, 20 feet on the waterline with a beam of 3 feet 4 inches, and draft of 8 inches, at a speed of fifteen statute miles per hour? The immersed girth at the greatest section is 4 feet, this section being 7 feet from the bow. The area of submerged section at this point is 1.6 square feet. M. J. H.

A.—The horsepower formula given on page 279 of our issue for July, 1906, and applicable for use in connection with motor boats is:

$H = \frac{AB}{K}$ where H is the horsepower required; A is a factor representing the influence of the displacement; B is a factor representing the influence of the speed, being in fact the cube of the speed, expressed in miles per hour; K is a factor selected by judgment, and ranging between 200 and 500. As the speed is increased, the factor K will tend to decrease; and, as the size of the boat is increased, this factor will tend to increase. As the lines of the boat become finer, the factor will increase, because it will obviously require less power to attain a given speed with a fine lined hull than with one of blunter lines.

The boat in question is 20 feet long, 3 feet 4 inches wide and draws 8 inches of water. If we assume her block coefficient to be 0.5, we find that her displacement will be about 1,425 pounds. Table 1 on page 279 gives for this displacement 1.26, as the value of A.

If we substitute in our formula 1.26 for A; 3,375 for B; and assume that the coefficient of performance may be represented by 300, this factor being made relatively small because the speed to be attained is very high for this size of boat; we find that $H = \frac{1.26 \times 3{,}375}{300} = 14.2$. It seems reasonable to suppose, therefore, that if an engine of 15 horsepower be fitted to this boat, a speed of 15 miles per hour might be expected.

Q. 378.—Kindly let me know the formula of how to find the horsepower of a marine naphtha engine. P. N.

A.—The method is the same as for a gasoline or steam or other marine engine of similar character.

Multiply the area of the piston in square inches by the average pressure exerted upon it in pounds per square inch. Multiply this result by the stroke of the engine in feet and by the number of impulses given to the piston per minute by the action of the gas, or naphtha vapor or steam, or whatever other agent may be used in the cylinder. Divide the product by 33,000, and the result will be the horsepower required.

Of the quantities above, the stroke and the area of the piston are obtained by measurement. The number of impulses per minute would be obtained by counting the number of revolutions per minute, which could be done either by means of an instrument for this purpose, or by placing the hand upon some reciprocating part and counting directly. In taking account of the number of impulses per minute, we must remember that double acting engines operating with steam give two impulses for every revolution. We must also remember that two-cycle gas engines, single acting, give one impulse for each two strokes; that is, one impulse per revolution. Four-cycle internal combustion single acting engines give one impulse to each four strokes of the piston, or one impulse to each two revolutions.

The only other factor in the formula is the pressure exerted upon the piston. This would be found ordinarily by means of an indicator diagram. In case, however, this method should prove to be unavailable, the pressure would have to be estimated, and the final result in horsepower could not be relied upon for accuracy to the same extent as when an indicator is used. It is usual in the case of gas engines which are not indicated, to assume a mean effective pressure upon the piston of about 80 pounds per square inch. In practice, the actual result may be somewhat above or below this figure, but this is considered an average. For naphtha, the same figure may be used. If steam is used, the average pressure upon the piston would depend partly upon the initial steam pressure, partly upon whether or

not a condenser is used, and partly upon the point of cutoff of the steam in the cylinder. For general marine practice, a rough approximation might be obtained by considering the mean effective pressure to be about three-fourths the difference between the initial pressure and the back pressure.

Examples.—Assume a single cylinder engine, 5 inches diameter and 6 inches stroke, receiving 280 impulses per minute. Assume a mean effective pressure of 80 pounds per square inch. Then horsepower $= \frac{5 \times 5 \times \frac{1}{4}\pi \times 80 \times \frac{1}{2} \times 280}{33{,}000} = 6\frac{2}{3}$.

If a steam engine of 5 by 6 inches, running 140 revolutions per minute, has an initial steam pressure of 100 pounds gage, and exhausts into the atmosphere, the back pressure might be assumed to be 4 pounds gage. Then horsepower

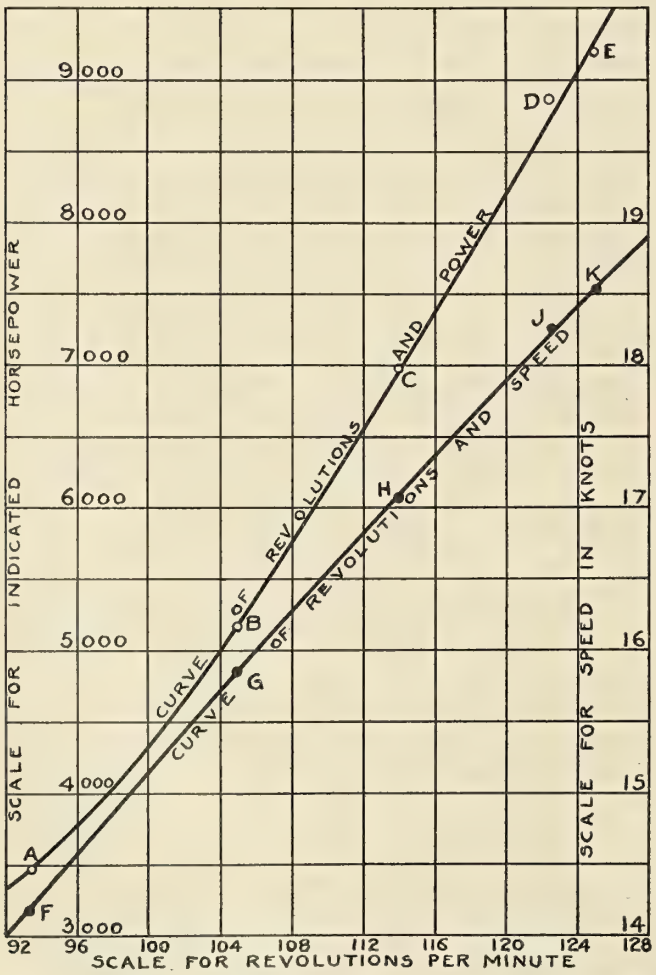
$$= \frac{5 \times 5 \times \frac{1}{4}\pi \times (100 - 4) \times \frac{3}{4} \times \frac{1}{2} \times 280}{33{,}000} = 6.$$

Q. 376.—Please publish in your next issue the method of the construction of simple curves of Revolutions and Speed; and of Power and Revolutions C. E. P.

A.—Let us assume data as follows:

	R. P. M.	Knots.	Horsepower.
First run	93½	14.18	3,495
Second run	105	15.86	5,163
Third run	114	17.06	6,971
Fourth run	122½	18.24	8,889
Fifth run	125	18.51	9,203

These figures are taken from actual results obtained on running a large ship over the measured mile.



If we prepare a diagram similar to the one shown, and let each one of the spaces along the scale for indicated horsepower represent 500; each one of the spaces horizontally along the scale for revolutions per minute represent 4; and each space along the vertical scale for speed in knots represent ½ knot; we will have the basis for the construction of curves of revolutions and speed and of power and revolutions.

We will first construct the curve of revolutions and power. The first run shows 93½ revolutions and 3,495 horsepower. The point *A* is so located with regard to the scale for revolutions per minute as to represent 93½; it is likewise so located with regard to the scale for indicated horsepower as to represent 3,495. In a similar manner, we locate the point *B* to represent 105 revolutions and 5,163 horsepower. In the same manner, point *C* represents 114 revolutions and 6,971 horsepower. Points *D* and *E* are located for the fourth and fifth runs, in the same manner. We will now take a curve, or, if we have no curve, will spring a batten, as nearly as we can through all of these points, and will draw our line to intersect all of the points possible. It will be seen that a smooth curve could not be readily obtained, which would intersect both *D* and *E*, which points are quite close together. Our curve, therefore, will be made to pass between these two points, as shown on the diagram.

The construction of the curve of revolutions and speed is performed in exactly the same manner. The point *F* is so located as to represent 93½ revolutions per minute, and 14.18 knots. The point *G* represents 105 revolutions per minute, and 15.86 knots. Similarly, points *H, J* and *K* are located for the revolutions and speed corresponding with the third, fourth and fifth runs. Our curve is drawn through these points in the same manner as before.

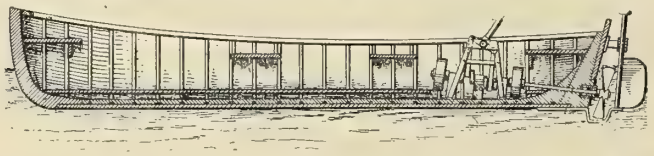
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

841,452. BOAT-PROPELLING MECHANISM. ROBERT RUTHERFORD, MONTAVILLE, OREGON.

Claim.—1. In a boat-propelling mechanism, the combination of a crank shaft, a member extending longitudinally of the crank shaft and rocking around an axis transverse thereto, and means connecting the ends of said



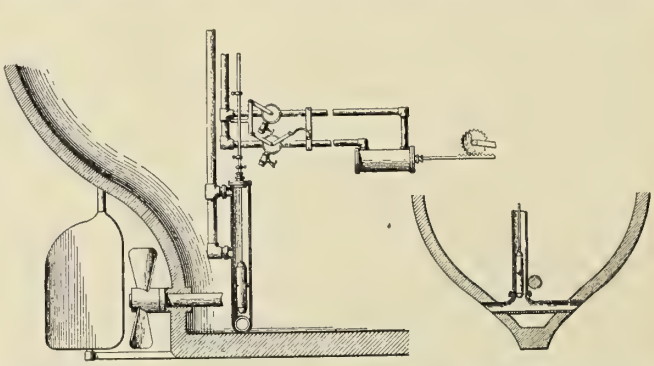
member with the crank, said means having a vibratory movement on said member to accommodate the throw of the crank, and also having a vibratory movement longitudinal of the shaft to accommodate the arc in which said member swings. Six claims.

841,719. COLLAPSIBLE AWNING FOR BOATS. ALEXANDER ROSS, CAMBRIDGE, MASS.

Claim.—1. An apparatus in combination with a boat, a plurality of rods along the length thereof, and a series of loop or ring ended frames slidably positioned thereon, said frames adapted to be spaced from the fore and after portion of the boat to amidship. Four claims.

843,803. MARINE-ENGINE GOVERNOR. SIMON A. FRASER AND JOHN M. NICHOLS, LORAIN, OHIO, ASSIGNORS OF ONE-THIRD TO JOHN J. KELLEY, LORAIN.

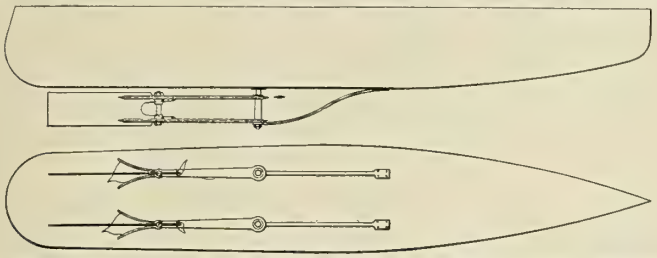
Claim.—2. In a marine-engine governor, the combination of a standpipe open to the water at the lower end, an air pipe of greater height having



one connection with the standpipe at its upper end and another connection with the same near its lower end, a float in the standpipe normally located above said lower connection, which connection is adapted to discharge water from the air pipe into the standpipe below the float when the water lowers therein, and means actuated by the float to control the throttle. Four claims.

842,278. OSCILLATING-BLADE OR FISH-TAIL PROPELLER. GEORGE E. WADE, LONDON, ENGLAND.

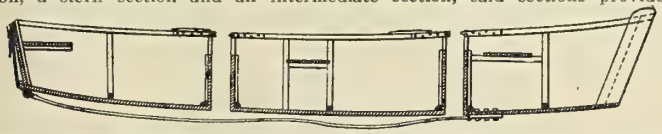
Claim.—1. An oscillating or fish-tail propeller consisting of a flexible propelling portion, the ineffective portion of which is cut away so as to reduce its resistance to the lateral movement of the propeller through the



water, a blade-carrying portion so shaped as to offer but slight resistance to the water, and curved fork-like projections provided at the free end of the blade-carrying portion for limiting the movement of the flexible propelling portion. Two claims.

842,349. SECTIONAL BOAT. NORMAN L. SKENE, SOMERVILLE, MASS.

Claim.—2. A sectional boat comprising in its construction a bow section, a stern section and an intermediate section, said sections provided



with watertight bulkheads at their adjacent ends, means located above the waterline for connecting the adjacent ends of said sections together, and a connection exteriorly located fast at one end to the bottom of said bow section, the other end of said connection detachably attached to said stern section. Nine claims.

842,856. WATER-BALLAST-CONTROLLING APPARATUS FOR VESSELS. CHARLES B. CALDER, TOLEDO, OHIO, ASSIGNOR TO THE TOLEDO SHIP BUILDING COMPANY, A CORPORATION OF MAINE.

Claim.—1. In a vessel having a plurality of water ballast compartments, a manifold in communication with the sea and communicating with each of said compartments through valve-controlled pipes, a pump associated with each of said pipes, and valves for opening and closing communication between said pumps and pipes. Seven claims.

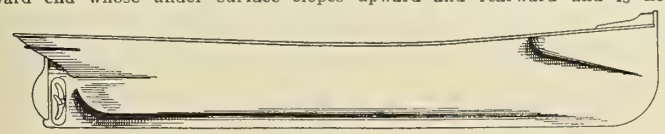
842,908. FOLDABLE OR COLLAPSIBLE BOAT. IRA O. PERRING, OF KALAMAZOO, MICH., ASSIGNOR TO LIFE-SAVING FOLDING CANVAS BOAT CO., KALAMAZOO, A CORPORATION.

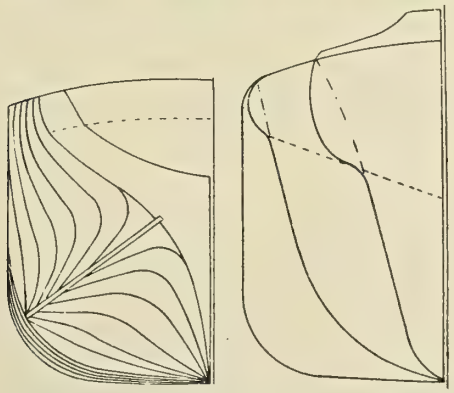
Claim.—30. In a folding boat, the combination of a suitable flexible skin; longitudinal ribs made up of overlapping sections adapted to telescope

upon each other; supporting straps, arranged in pairs, adapted to receive the overlapped ends of said rib-sections; cross-ribs arranged over said longitudinal ribs; a centrally arranged connecting strap for said cross-ribs; and a keel arranged over said cross-ribs, adapted to apply tension to the said connecting strap. Thirty-nine claims.

843,016. HULL FOR SHIPS. OLAF HOLBY, CHRISTIANIA, NORWAY.

Claim.—2. A ship's hull having a forward bilge projection at its forward end whose under surface slopes upward and rearward and is nor-





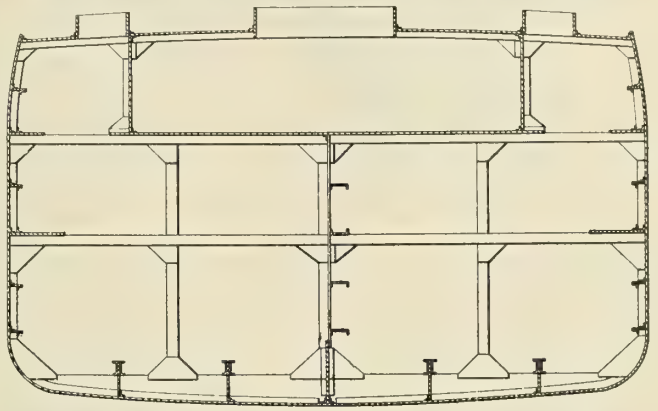
mally above the waterline, and a bilge projection at each side of the keel at the stern projecting downwardly and outwardly and inclined upwardly toward the rear, and concave surfaces connecting the bilge projections with the keel and extending upwardly toward the rear, whereby the pitching of the vessel will propel it forward. Two claims.

845,659. AUTOMATIC PROPELLING LIFE-PRESERVER. WILLIAM LUCE, SEASIDE, OREGON.

Abstract.—The object of the invention is to produce a device which will assist the swimmer to float, and to propel himself through the water. Two claims.

843,390. SHIP FOR CARRYING LIQUID CARGOES IN BULK. CHARLES E. BURNEY, NEWPORT NEWS, VA.

Claim.—3. A ship for carrying liquid cargoes in bulk, comprising tanks in the ship's bottom, a main or tank deck covering the same, bulkheads



upwardly extending from the tank deck forming, in connection with the shell of the ship, expansion trunks at each side of the ship, and a compartment for the general cargo of the ship, intermediate the bulkheads, and a hatchway over each of the expansion trunks and over the central compartment. Four claims.

844,372. LIFE-BOAT. CARL LEHNERT, MARXLOH, GERMANY.

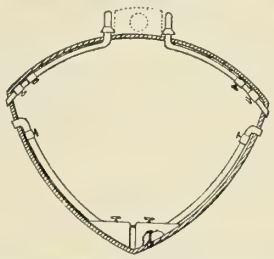
Claim.—Life-boat, comprising in combination, a lower part made of aluminum mixed with suitable metal alloy, an upper part hinged to said lower part and made of the same material as said lower part, a tightening placed between said two parts, fly-screws passed through the projecting inner edges of said two parts and adapted to hold them tightly and rigidly together, a glass provided at the front end of the boat and adapted to allow an inspection toward the sea from inside the boat, paddle-wheels arranged outside the boat so as to reach into the water and passed with their axles through stuffing-boxes in said upper part of the boat so as to be capable of being actuated from inside the boat, a rudder provided at the rear end of the boat and also passed with its supporting-axle through a stuffing-box in the rear end of the boat, so as to be capable of being operated from inside the boat, an air-inlet pipe provided at the top of the boat and adapted to be closed and to be made longer if required, and a safety-flap provided in the top of the boat. One claim.

845,477. BOAT-RELEASING DEVICE. HARRY G. OLIVER, NEW YORK.

Claim.—1. The boat-releasing device consists of uprights secured in the boat, weighted hooks pivoted to said uprights near the upper ends, and the points of which are adapted to pass through apertures formed in the ends of said uprights, means for locking said hooks in their closed position, pulley wheels connected with the pivoted portions of said hooks, and flexible devices connected with the opposite side faces of said pulley wheels and passing beneath pulleys mounted in the bottom of the boat and connected between said pulleys. Five claims.

845,620. LIFE-BOAT. GEORGE O. DITTON, LANOKA, N. J., ASSIGNOR OF ONE-HALF TO EUGENE A. RUMSEY, PHILADELPHIA.

Claim.—2. In a life-boat comprising a hull, an inclosing deck therefor, air pipes for supplying air to the interior of the boat and having the opposite ends thereof leading through the hull and deck of said boat, valve



means for governing the passage of air from the air pipes to the interior of the boat and adapted to cut off such supply of air, other valve means for closing the outlet end of each air pipe when the air is being supplied to the interior of the boat by said pipe, the last-mentioned valve means, however, being operable to open the outlet end of each air pipe and permit of escape of water which may be received in said air pipe. Four claims.

845,937. STEERING AND PROPELLING MECHANISM FOR BOATS. WILLIAM H. FAHRNEY, CHICAGO.

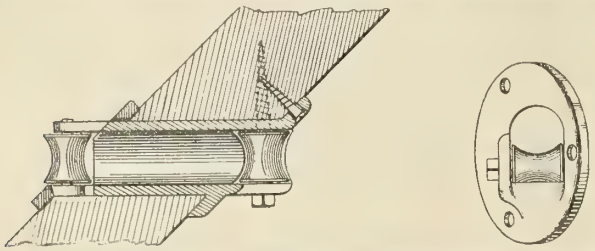
Abstract.—The invention relates to improvements in steering and propelling mechanism for boats and the like, and more particularly to flat bottom boats. The object is to provide an improved form of propelling means which is also adapted to steer or guide the boat. A further object is to provide an improved form of laterally shiftable and vertically adjustable propelling mechanism. A further object is to provide mechanism for this purpose which will be simple and cheap in construction, easy to manipulate, and effective in operation. One claim.

846,736. SUBMARINE TORPEDO BOAT. ALFRED ELGAR, NORTH BRIXTON, ENGLAND.

Abstract.—The invention has for its objects to enable submarine or submersible torpedo boats to carry and release buoyant torpedoes, self-attaching or otherwise operated or directed either in a vertical or in a horizontal direction; to cut or otherwise destroy the cables attached to moored torpedoes or submarine mines; to carry externally four or more torpedoes vertically directed ready for immediate use, and to carry also other torpedoes to be horizontally directed; to enable submarine or submersible boats equipped with buoyant torpedoes to be carried by a battleship from which said boats can operate as a base; to enable them, if sunk, to indicate their position by means of buoys automatically released; to enable such boats to be fitted with eyes or hooks to which attachments may be made for readily raising a sunken boat; to enable them to be used to place submarine mines in any desired field for harbor or coast defense and other purposes. Three claims.

846,244. HAWSE PIPE. CHARLES PETRIE, ST. JOHNS, NEWFOUNDLAND.

Claim.—1. A hawse pipe having a depression in its outer face, said depression having an upwardly extended lip at the outer side thereof, a roller



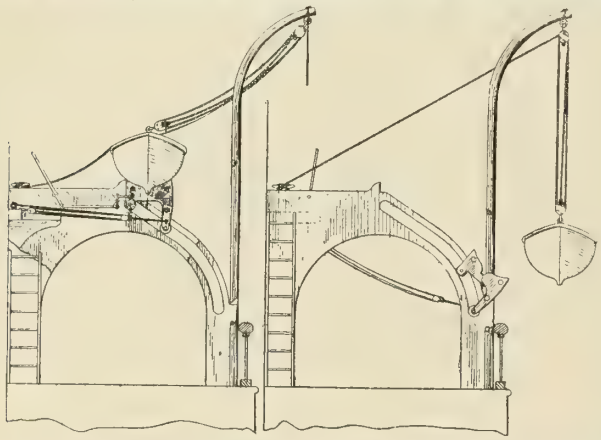
located in said depression and projecting above the lower surface of the pipe, a collar on the opposite side of the hawse pipe from the roller, and a roller journaled in the collar. Four claims.

846,417. PROPULSION OF SUBMARINE VESSELS. SIMON LAKE, BRIDGEPORT, CONN.

Abstract.—The invention consists, essentially, in a hull preferably provided with a substantially flat deck and fixed lateral guide planes serving to maintain a fixed direction of travel in a given plane of motion under the impulse of its propellers operating in a substantially parallel plane, combined with a rudder near one end of the vessel mounted upon a horizontal pivotal support, and adapted to be inclined thereon, to forcibly overcome the steadying tendency of said flat deck and guide planes. Four claims.

846,770. LIFE-BOAT LAUNCHING MEANS. RICHARD ZOLLING, OAKLAND, CAL.

Claim.—1. A means for launching a life-boat, comprising arched supports, a cradle movable thereon, lugs extending outwardly from the respective sides of the cradle, means detachably engaging said lugs for holding the



cradle in locked position, mechanism for actuating said means, and guide devices carried by the cradle, which coact with the arched supports, said devices after the cradle has been released causing the same to move outward at a downward inclination, so as to swing the life-boat clear. Seven claims.

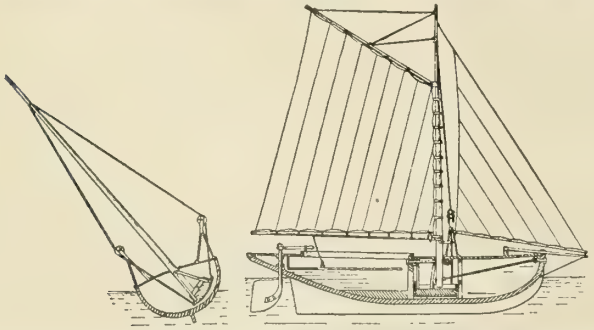
847,222. PROPELLER. ALONZO L. AMES AND BYRON S. AMES, NEWBERRY, PA.

Claim.—1. A propeller comprising a hub and a blade, the latter being curved longitudinally from front to rear and having at its rear edge a reduced rearward extension disposed adjacent its outer end and presenting a restricted point at which the water is discharged rearwardly from the blade, said blade being also pitched at a transverse inclination on a line oblique to the axial line of the hub. Two claims.

British patents compiled by Edwards & Co., chartered patent agents and engineers, Chancery Lane Station Chambers, London, W. C.

23,367. BALLASTING BOATS. T. JENSEN.

The mast of a sailing boat is pivoted on a bolt, from which hangs a weight in a cradle. The sides of the weight are attached to the upper end of the mast by cords passing over pulleys. As the wind inclines the boat, relative movement takes place between the mast and vessel, the mast swinging on the bolt. This movement is transmitted to the weight by the cords



causing it to move further towards the side of he vessel than it would if attached to the bottom of the mast. The influence of the weight increases more rapidly than the inclination of the mast. The bolt is journaled in transverse beams beneath the deck, and the lower end of the mast is connected to a bolt in the stem of the boat by a bar.

21,974. SHIPS' TELEGRAPHS. A. J. GRANT.

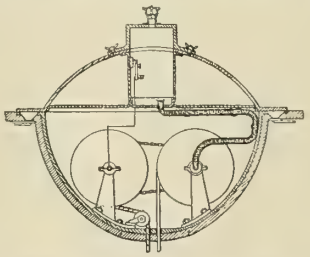
In mechanical telegraphs for ships, in which the receiver and transmitter are connected by shafting, an intermediate actuating mechanism is adapted to be thrown into and out of gear with the shafting, so that the apparatus can be actuated from two or more places. The transmitting hand wheel has a greater movement than is required to move the indicating pointer. The wheel drives the shaft through bevel gearing, and a clutch, which can be brought into action by a hand lever. A receiving instrument has its pointer moved over the dial by bevel gearing from the shaft.

23,169. CLEANING SHIPS' HULLS. J. A. K. McGREGOR.

This comprises an apparatus for cleaning the hulls of vessels when under way, in which a brush is operated by a motor contained in a watertight casing held to the ship's side by electro-magnets. Wheels are mounted on the exterior of the casing, or may constitute the magnet poles. They are operated from the motor through spur wheels and chain gearing. The cleaning tool or brush is operated by eccentrics driven from the shaft. Springs maintain the brush against the ship's side. Wheels provided for sideway movements are driven by separate motors through worm and chain gearing. The brush or cleaning tool may be rotary instead of reciprocating, and the magnets are normally a slight distance from the surface to be cleaned. When the apparatus is used in dry-dock a chemical solution, hot air, steam jets or the like may be directed through the apparatus on to the ship's hull, to assist in the removal of incrustation.

23,520. SUBMARINE VESSELS. B. G. NARISCHKINE.

Comprises improvements in the type of float normally housed in a recess in a submarine vessel, and adapted to be disengaged and rise to the surface in the event of accident. Two drums are fitted within the float, upon which are wound a flexible air tube and a cable. The drums are geared



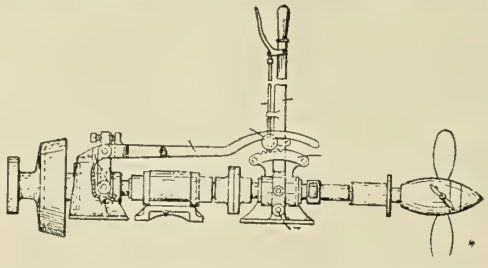
together by a chain, the one on which the air tube is wound being a little in advance of the other, so that the cable takes all the tension. The outer end of the air tube is connected with an airtight chamber fitted with an outwardly opening valve, which is opened when the float reaches the surface of the water by the excess of pressure within, or by an explosive cartridge. A pawl maintains the valve in its open position. The float is fitted with extra airtight compartments and is released by turning the conical-headed bolts from within the vessel.

23,607. SHIPS' TELEGRAPHS. W. CHADBURN.

Relates to order apparatus for ships, in which the receiver comprises three or more solenoids, adapted to be energized in sequence by currents sent over separate line wires from the transmitter, the cores of the solenoids acting on a crank so as to rotate the pointer of the receiver. The cores of the solenoids are connected to the crank by arms, so that the pointer can be rotated in either direction, according to the order in which the solenoids are energized. The transmitter may have several sets of contacts, corresponding contacts of each set being connected together and to one of the solenoids by line wire. The transmitter contacts may be double, so that the contact on the handle may stand between the twin contacts in its position of rest, no current then flowing. The cores of the solenoids are held in position, after actuation, by providing an iron piece at the outer end of the solenoid, so that when the core moves in, it is attracted by the iron piece and is held by it at the end of its stroke, thus keeping the pointer at the center of its order.

23,638. PROPELLING BOATS. GAINES REVERSIBLE PROPELLER COMPANY.

Relates to interlocking controlling means for the clutch and reversing gear of boats fitted with internal combustion engines driving screw propellers having adjustable blades. A lever controlling the propeller blades is pivoted and provided with a locking rod engaging notches in the quadrant. A



roller connected to a rod, so as to be raised and lowered therewith, engages the long arm of a bell crank lever which operates the clutch, so that the clutch is disconnected when the locking rod is raised for the purpose of adjusting the propeller blades. Another construction is shown suitable for heavy motors, in which the lever is adjusted by means of worm gearing and a hand wheel, the movement of the hand wheel handle serving to disconnect the clutch.

23,915. SHIPS' ARMOR. J. P. SERVE.

Armored ships are fitted with deep frames, secured to the outer plating by angle irons. The frames are connected by planks, which pass through perforations in the frames. The spaces between the planks are filled with other planks, constituting a solid wooden backing. Bolts secure the whole structure together. The armor is provided with rabbeted edges, to secure a smooth exterior surface. The studs are bored out along a part of their axis, and are provided with transverse passages so that tar may be injected. The opening is then plugged.

For the first time in history, two Japanese warships are visiting the port of New York. They are the *Chitose* and the *Tsukuba*.